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BRIEFLY TOLD.

THE GAS COMPANY AND ITS CUSTOMERS.—At the July meeting of the Pacific Coast Gas Association, Mr. Gregory, of the San Jose (Cal.) Light and Power Company, read a paper[1] on the subject of the "Treatment of Our Customers," and although that topic is quite as old as is the gas business itself, the San Jose gas man nevertheless managed to put together a very entertaining chapter, with a hint or two therein which had the flavor of originality about them. And this leads us on to say, and it is but a repetition of what we have said more than a score of times, that be a subject ever so old or ever so often discussed, if it only is a vital one, a propounder thereon need have no fear that his thesis will be either tame or lack originality, for everyone's experience respecting a given branch of trading must differ from that of his predecessor or contemporary. True it is that the underlying principle, and perhaps the main method of action as well, will not be wide in variance, still there is the individuality of separating action from practice existing to give change and direction to each one's doings on similar lines. All of which is meant as a hint that compilers of papers for the meetings of our Associations would come on in greater numbers did they bear in mind that the triteness of a subject, because of its name, is no bar whatever to originality in its treatment. Coming back to Mr. Gregory's contribution to the paper list of the Pacific's last convention, which in no wise lacks originality of treatment, we submit that he is fully up-to-date, in writing it down that the professional canvasser can sell anything, even wooden nutmegs, for a time; but that canvasser's time is short in the field first selected by him. His particular field once "worked," is closed to him for good; and the next particular field is also but of short duration, wherefore he eventually is without field and without trade, for "fields" must finally come to an end, so far as new ones are concerned. It is true he may have amassed a fortune, meanwhile, but as there are others to follow him who must live, it is a fact undeniable that they have a hard road to travel. The gas company, however, is a fixed institution which may not take up its pack to the next town, so it must look first and last to the people among whom it originally locates for subsistence and advancement. And so it looks particularly sensible in Mr. Gregory to suggest that the canvasser for the gas company, on gas stove account, for instance, would be more than a knave, and twice more than a fool, who would secure a purchaser for a gas stove by representing that the cost of keeping up the same as a successor to a coal range would be only half that which the user thereof would speedily determine because of actual trial. Still this very thing has been done, and even though the blame thereof properly rests with the canvasser rather than with the company, the rara avis of a gas consumer who would put the blame on the right shoulders has not even been hatched out in the incubating season of 1895. Nor is the consumer to be greatly blamed for his failure to charge the lie to the liar. However, this only goes to show that canvassers should be watched by their employers as sharply as it is possible to watch them, and it further goes to show, at least to us, that the gas stove canvasser should be paid a stated salary rather than that his recompense should be in the form of a commission, or even in the nature of part salary and part commission. Mr. Gregory's remarks, too, on the placing of Welsbach or other im-

1. See JOURNAL, *ante*, p. 251.

proved lamps, are certainly in line with the times, and this is particularly true of his well put together assertion: "We may calculate that the loss we sustain through displacing the naked flame with the Welsbach is the price we pay for advertising and introducing the Welsbach into hundred of houses where we would otherwise have no consumption of gas." This loss by such substitution is more apparent than real, but some merchants still exist who prefer the slow quarter to the nimble dime—they "exist," though; they never advance; and they finally are absorbed, failing which they are buried. Mr. Gregory's paper is well worth conning, and its suggestions are well entitled to trial—and the Pacific Coast is a pretty good field for trying them on, since in the olden days the gas pioneers of that region were inclined rather to pile up capitalization than to cut down the price of gas. In the discussion that followed, Mr. Britton, of Oakland, Cal., and Mr. Walton Clark, of the United Gas Improvement Company, laid down the law with fairness and commonsense, respecting the treatment of consumers; and we have no doubt that Mr. Britton would have been able to make a much better showing in Oakland practically were it not for the fact that the "pioneers" of the Oakland Gas Light and Heat Company managed to pile up a capital, between stock and bonds, amounting to $3,350,000, which certainly ought to be sufficient for a works, the annual sendout from which does not exceed 70,000,000 cubic feet—the concern, however, has an electric lighting annex.

NOTES.—Mr. Eugene Hyde, the youngest son of Mr. Gustavus A. Hyde, of Cleveland, O., has resigned the dual position of Secretary and Superintendent of the Ravenna (O.) Gas and Electric Light Company, in order to accept the position of Superintendent of the Colorado Springs (Col.) Gas and Electric Light Company. The youngest son of his father is a level-headed, enterprising man, and we know that his course will be onward and upward.——A correspondent forwards the following: "An idea of the enormous amount of business transacted at the factories of the Welsbach Company, Gloucester, N. J., may be gleaned from the statement that for the various laboratory, mechanical, heating, testing and other uses, a volume of gas is required very much in excess of that sold daily by the local Gas Company, which latter is supplying gas to a prosperous and busy town having not less than 7,000 inhabitants. In point of fact the present equipment of the factory is so rapidly becoming inadequate that the gas works department is now being entirely overhauled by the United Gas Improvement Company, which Company is installing one of its standard sets of Lowe apparatus, up to a rated daily capacity of 1¼ million cubic feet, in addition to the present apparatus having a daily capacity of 100,000 cubic feet—the smaller plant will not be dismantled. The contractors have also agreed to put in a new purifying plant, the dimensions of the boxes to be 10 feet by 12 feet by 4½ feet. This means a 'factory plant' of noble size, surely, and one which the local Company should have taken strenuous efforts to prevent, by securing the Welsbach Company for a permanent customer. It is not intended, from my point of view, that the 'factory plant' will compete with the local Company for the general gas supply of Gloucester City. The Welsbach Company is ready to assert that after the completion of its new gas plant, delay in the filling of orders will at least not be occasioned by reason of lack of gas supply."——The Committee on Light, of the Richmond (Va.) municipal gas works, is still in a retrenching mood, the salaries of the clerical force having been cut down, the average reduction amounting to about 45 per cent. ——Mr. Kirkham, the Superintendent of the Citizens Gas and Fuel Company, of Terre Haute, Ind., has declined to continue in that position. He preferred to resign rather than accept a post less responsible than the one formerly held by him.——The itinerant meter inspector has re-appeared in Detroit. What is the matter with the local official inspector? Is he not up to the requirements of his office?——The matter of measuring natural gas by meter is a feature in the political contest for control of the next City Council of Indianapolis, Ind.——The City Council of Indianapolis, Ind., has decreed that all telegraph and telephone wires in that city shall be placed underground "within a reasonable time."——The electric lighting systems of Milwaukee, Wis., seem to be under the dominion of the Milwaukee Street Railway Company, for in the invited competition for bids for the public lighting of that place, the Railway Company was the only proposer. The figures submitted were on the basis of 5-year or 10-year contracts, the Company agreeing to furnish arcs (2,000-candle power nominal) for $109 per annum each during the short term, the long-term rate to be $105. In the districts of the city where overhead lines are permissible the Company's bids were $92 and $87, respectively, for the long or short-term contracts.——The Chairman of the Fire, Water and Light Committee, of Ingersoll, Canada, asks for tenders for the public lighting of that place, either by gas or electricity, or both, the contract to run for five years.

Hydraulic Stoking Machinery and Labor-Saving Appliances in Modern Gas Works.

[Read by Mr. A. S. Biggart, of Glasgow, before the Institution of Mechanical Engineers.]

The conditions of labor in almost all industries have undergone, and are constantly undergoing, continuous modification and improvement, due principally to the ever-increasing uses to which mechanical appliances are being adapted. This statement may be aptly made of many of the modern gas works, for in no industry have the conditions of work been more radically altered. The bulk of the labor employed in gas works is absorbed in the retort house in the handling of the coal previous to and after carbonization.

In works where hand labor is chiefly employed, according to the old methods which still retain sway in the great majority of instances, the following may be taken as representing the general routine of those having the most approved arrangements. The supply of coal is usually brought by rail to the position most convenient for the retort benches, where the wagons are emptied by hand. If necessary, as is generally the case, the lumps are broken into suitable size by hand. The retorts are next charged by hand labor, and after carbonization is completed, the coke is withdrawn, also by hand. The coke is either wheeled out to the yard, or may fall below the floor to a lower level, to be there quenched by water. The surplus, beyond what is required for firing, has then to be removed to the yard. In the yard, hand labor is again called into requisition, to screen the coke and fill it into the carts or wagons, for distributing it to the consumers. The variations in the details of the handling are such that scarcely two works follow the same routine, and the foregoing outline can therefore be taken only as generally representative.

The same remark also applies to the following outline of the routine pursued in works where labor-saving appliances are largely used. The supply of coal in such modernized works is usually delivered direct from the railway truck into the coal breaker. After passing through this machine, and being all reduced to proper size, it is raised by an elevator to a large hopper, so fixed that the coal can be automatically delivered into the hopper of any of the charging machines. The charging of the retorts is then done altogether mechanically, by means of a hydraulic charging machine, by which it is done more evenly and otherwise better than by hand. After carbonization the coke is withdrawn again mechanically by a hydraulic drawing machine, entailing a minimum of labor to the attendant. The surplus coke, guided in its descent by shoots, falls into a bogie underneath the floor, and is run out to the yard. In some instances, beneath the stage floor are placed conveyers, on which the coke is carried to circular revolving screens, whence it is delivered into large storage hoppers, or into the railway wagons, or into bags for small consumers.

The old methods involve continuous and repeated operations performed by hand, while the new are such that no hand labor is employed in dealing with the coal, from the time it leaves the railway truck till it arrives there again in the form of coke. Thus hand labor is entirely superseded by mechanical power, to the great advantage of the laborer and employer alike. The number of men required in the retort house under the new system is not half that needed under the old method. The saving which this represents, after allowing for maintenance of plant and interest on additional capital, will average about 25 cents per ton.

As the quantity of coal which might be carbonized annually in this country under the improved system will amount roughly to about 8,000,000 tons, the saving to the gas consumers would be about $2,000,000 per annum, if stoking machinery were fully adopted. Stoking machinery is not of recent date, though successful plant for such work has been used only a comparatively short time. For the successful working of the stoking machines, considerable auxiliary machinery is necessary.

The coal breaker into which the coal is delivered direct from the trucks by shoot or otherwise, varies greatly in strength, according to the different classes of coal; but the principle of the machine is in nearly all cases the same. Fixed over the breaker is a hopper, which is kept filled with coal, thus maintaining always a supply of coal directly in contact with the two top rolls, each of which has a series of claws shaped in cast steel, and working into one another, thus drawing in and breaking the coal in its passage through the rolls. Here it is only partially broken; but it falls directly upon two other rolls, which break to suitable dimensions any remaining larger pieces. These lower rolls are set closer to each other than the upper pair; and their crushing teeth are much smaller, and of a different form. The coal deliv-

ered from these lower rolls is raised by an elevator to the large storage hopper, from which the various charging machines draw their supplies. The breakers are necessarily of a strong design. The cheeks and gearing are of steel throughout, and in all other respects the machines are made equal to the exceptionally heavy work required of them. The elevators are of the usual kind, raising the coal in buckets fixed at short intervals on a travelling link chain, which passes round two revolving wheels—one fixed at the top and the other at the bottom of the steel framing that carries the whole. In passing round the lower wheel the buckets dip into the coal to be raised, and in turning over the upper wheel, they tip it into a shoot leading to the storage hopper.

Each charging machine has to serve a large number of retorts at varying heights, and also at varying distances from one another. Consequently, the range—that is, extent of retort bench surface requiring to be effectively served by the charging machine—is considerable. The horizontal range is obtained by laying rails parallel to the retort bench, along which the charging machine may travel. The vertical range is secured by raising and lowering the charging or drawing apparatus on the machine, by means of a hydraulic ram, which is fixed to the machine itself. In addition, therefore, to the coal regulating and charging apparatus, the body of the charging machine has to be provided with gear for traversing and raising and lowering, while on the top of the framing, at a sufficient height, a large hopper is permanently fixed, capable of carrying from 2 to 5 tons of coal, or a still larger quantity if desired. The regulating gear, for delivering from the hopper in greater or less quantities the coal with which the retorts are to be charged, is securely fixed immediately underneath the hopper.

The whole of the motions are automatic, and are regulated by a single lever. The first step is to drop from the hopper, by means of the coal regulating apparatus, a certain quantity of coal in front of a pusher plate, by which it is then pushed into the retort, and delivered by a series of six or seven pushes into successive positions—beginning from the far end, and extending forwards through the whole length of the retort. These positions are so close to one another, and the form of the pusher plate is such, that the charge is left practically level throughout the retort. The apparatus for accomplishing this work consists of a horizontal slide beam, on which are placed two hydraulic rams—one for giving the forward movement to the pusher plate, and the other for drawing it back. Alongside the forward or pushing ram is a turning shaft, carrying a series of stoppers, which come into play in rotation as the shaft is revolved, and bring the pusher plate to a stand in the successive positions of its stroke, so as to spread the coal evenly over the whole length of the retort. When the drawing ram bringing the pusher plate back is near the end of its stroke, it actuates the lever of a hydraulic valve, which, in opening and closing, puts in motion and also stops the coal feeding and regulating supply.

This gear consists of a divided drum, revolving underneath the coal hopper, and put in motion at regular intervals by means of a combined hydraulic ram and rack, with wheel and rachet gear, worked as already mentioned. The hand lever regulating the pushing and drawing rams serves also to lower the pusher into position when entering the retort, to raise it before returning, and also to revolve the stopper shaft for spreading the charge in the retort. The usefulness of the charging machine is enhanced by the provision of various adjustments—such as means to vary the quantity of coal in a charge. This is effected by altering the length of stroke of the co-regulating ram, thereby giving a greater or less movement to the revolving coal feeding drum. A larger or a smaller quantity of coal can also be placed at any particular part of a retort, if this should be desired owing to the temperature of the retort varying at different points.

This charging machine has now been in regular use for over two years, and is giving every satisfaction. Like all such work, it has reached its present advanced state of efficiency only by a process of development. The first charging machine made of this kind was an experimental one; and while the main features have throughout varied little from the original design, the details have been considerably altered. In the experimental machine, the coal hopper was attached to the charging apparatus, rendering it essential, when any change of height was required, to raise and lower the hopper and its contents. In all subsequent machines, this position was discarded, with the exception of one machine specially so fitted, which is still doing good work. The alteration was found desirable, owing to the limit practically put on the coal capacity of the hopper, and also on account of the loss of time in raising and lowering the extra load. It was further found that the new plan gave a more compact design than the old. The coal feeding drum was at first rotated by causing the back end of the pusher rod, when near the outer end of its stroke, to strike and carry with it a connecting rod attached to a lever with pawl and ratchet combination on the drum shaft. Owing to the sudden blow, however, this did not work satisfactorily. A single-acting hydraulic ram then took the place of the connecting rod, with a spring opposite the ram to force it back; the ram being worked by a valve with a lever, as at present. Although this alteration proved a great improvement, it was found desirable to replace the spring by a second hydraulic ram, as now adopted; and this change was followed with the best results.

In the experimental machine, only fairly large pieces of coal were at first dealt with; and with these no trouble at all was experienced. As small coal, however, is extensively used in some gas works, a trial was made of it, with the result that, when once the coal began to run between the drum and the face plate opposite, it sometimes did not cease running until the hopper was empty. As the opening could not be reduced without the risk of large coal jamming, and as each machine ought to be suitable for large and small coal alike, it was found essential to adopt some arrangement capable of dealing with any sizes. The difficulty was simply and effectually solved, by fixing in the coal space in front of the drum a swing plate, having a lever and weight so attached as to cause it to press the coal against the face of the drum, and thus automatically to close, by a sort of flap or clack valve, the space through which the small coal formerly ran freely. The revolution of the drum moves back the flap valve without difficulty, and allows the coal to flow freely when charging.

Another point, for which it was not at first thought necessary to make any special provision, was the momentum of the coal feeding drum when in motion. The amount of travel or rotation of the drum after the hydraulic ram had come to a stand, was found to vary greatly. This was owing to the vanes in the drum being often in a different position in relation to the clack plate at the moment when the hydraulic ram ceased to exert its power. The evil effects were reduced to a minimum and rendered unimportant by simply fixing a continuously acting brake wheel and brake on the end of the drum shaft.

A machine of this kind is naturally subject to a considerable amount of vibration and shock when in use, and especially is this so with the class of labor usually employed. For various reasons, the former stokers are put to work these machines, which consequently have frequently to stand an amount of rough usage not usually associated with hydraulic machinery. Various minor matters revealed this usage. One was the effect on the copper tubes. More than the usual number gave way at the couplings, although the tubes themselves were of ample strength, the working pressure being only 400 lbs. per square inch, while they were strong enough to stand a working pressure of 1,000 lbs. It was therefore found desirable to alter the form of joint, and at the same time still further to increase the strength. The change consisted in simply putting in heavier copper tubes, and, instead of screwing the collars on at the ends of the tubes, in flanging the copper over, and soldering the collar behind the flange. Other minor details have also been improved, and modifications will no doubt continue to be made as the experience of actual working is gained.

About a year ago it was thought desirable, with a view to increasing the capacity of the coal hopper on the machine, to introduce mechanical power for traversing it along the floor, and a hydraulic motor was designed and made for this purpose. Hydraulic power being already used in the machine was naturally deemed the most suitable means to adopt—more especially as the load to be moved is a fairly constant one. It was decided to employ two hydraulic rams, with racks working in the opposite sides of a spur wheel, which is free to rotate backwards and forwards. On this wheel are secured two pawls, each working in a spur wheel alongside the first wheel. As the first wheel moves in one direction, the pawl in gear on one of the side wheels goes with it, and on the motion of the first wheel being reversed, the second pawl takes the other side wheel in the opposite direction. Each of the side wheels revolves a separate miter wheel, and as the two miter wheels are geared into the opposite sides of a common miter wheel, the latter will revolve continuously in one direction. This common miter wheel is keyed on a shaft that is geared with the main axle of the machine, through which it traverses the charger backwards or forwards as desired. To reverse the motion of the common miter wheel, it is only necessary to reverse the action of the two pawls gearing into the side wheels. The hydraulic rams receive their water through a 3-ported slide valve, which is made to reverse by a secondary key valve. The latter is controlled by a double lever, which is actuated by the two hydraulic rams themselves as they approach the outer end of their stroke. A simple arrangement of lever gear has been adopted for reversing the pawls, so that, by moving a hand lever, the action of the hydraulic motor sends the charging machine in either direction at the will of the attendant. In order that

the charging machine may be more completely under control while travelling, a brake has been added to the motor; so that, when the machine is nearing the stopping point, the water is cut off, and the brake brought into action.

While the charging machine is employed in filling the retorts with coal, the drawing machine is for the reverse operation of withdrawing the charge from the retorts after it has been converted into coke. For this purpose, a rod having a plate fixed at its end is used, similar to that which pushes the coal into the retort in charging. But for withdrawing the coke, the plate can be held in either a vertical or a horizontal position. It is held horizontal while the rod is being inserted into the retort above and clear of the coke in the distance desired; and it is then lowered into the vertical position, so as to cut into the coke, and drawn forwards, bringing in front of it part of the carbonized charge.

The action of the drawing machine is so similar to that of the charger that there is considerable similarity in some of the parts. The arrangements for travelling the machine along in front of the retort bench, and for raising and lowering the slide beam which carries the withdrawing rake, are in principle similar to the equivalent arrangements in the charger, though differing in detail. The drawing machine is so light in itself that it is unnecessary to apply mechanical power for traversing it backwards and forwards, as is done in the case of the charger. The drawer consists essentially of a carriage fitted with travelling gear, and having a bow frame fixed near the center, which carries the slide beam, with its pushing and drawing rams and connections for actuating the rake. This bow also carries the hydraulic ram for raising and lowering the slide beam as required. The rake is pushed into the retort and drawn out again by simply reversing a hand lever, the motion of which not only reverses the valve, but also raises the point of the rake head at the beginning of its stroke, and lowers it at the end of the stroke. The rake is raised as it enters the retort, and passes over the coke. It is depressed again before beginning the return stroke, thus dipping into the coke, and raking it out at every draw.

The number of retorts charged or drawn per hour by these machines varies to a considerable extent in actual work. In some cases, owing to special circumstances, not more than 24 per hour are available for each machine; while in other more favorable instances as many as 48 per hour are allotted to each, and even with this larger number a reasonable time remains for rest for the stokers at the end of each hour. The labor of charging the retorts and withdrawing the coke is much lightened by these mechanical means; and the number of retorts charged and drawn for each stoker employed is largely increased. It might at first be imagined that coal placed in retorts in only six to eight large charges by the machine would not be so evenly laid as a much larger number of smaller charges put in by hand. The machine, however, lays the coal by far the most evenly, owing partly to the shape of the pusher head, which is bevelled so as to allow the small ridge of coal raised in pushing forwards to fall back when its support is removed on the withdrawal of the pusher head. Another advantage possessed by machine work over hand labor is that the charging is done more quickly, and thus there is a diminished loss of gas before the retorts are sealed up.

Apart from any other consideration, the mechanical charger could not fail to prove beneficial in view of the greatly improved conditions under which it enables work of a most trying nature to be carried on. The old method of hand charging was a severe ordeal for the stokers, requiring great exertion to get through the work in the shortest time possible, while exposed throughout to a high heat. Such adverse conditions are now entirely done away with where mechanical stoking obtains. The single lever by which the whole of the operations are controlled is worked from such a position that the attendant is quite removed from the discomfort of close proximity to a high heat, while at the same time the former severe bodily exertion is replaced by light and easy work. Even greater improvements in the conditions of labor arise from the introduction of the drawer, which accomplishes, under all the better conditions attending the use of the charger, work of a still more trying nature. The withdrawing of the live coke from the retorts was work for which even the stokers themselves, accustomed as they were to it, admitted that mechanical appliances were required. Here, again, all is worked by a single lever, in such a position as to remove the attendant from the former discomforts of withdrawing the coke at a white heat at the mouth of the open retort.

In conclusion, the author said that the hydraulic power employed at the pressure usually of about 400 pounds per square inch, is distributed in the way generally adopted for similar installations. He showed by means of drawings various typical methods of handling the coal and coke, and he remarked that about 200 of these machines are now in use or in the course of manufacture. They have been adopted at many of the largest gas works in this country and abroad, including those of Glasgow, Birmingham and Liverpool, the South Metropolitan and the Gas Light and Coke Companies in London, and the Vienna and Amsterdam stations of the Imperial Continental Gas Association. In Glasgow, where the Corporation have adopted the machines for all their stations, the quantity of coal dealt with by them amounts to about 500,000 tons per annum.

Discussion.

Mr. W. Foulis testified to the satisfactory way in which the machines worked. He said they ran night and day without giving the slightest trouble, and their introduction had effected a great saving of money.

Mr. Flett said there was no doubt that mechanical retort stoking was much better than hand labor, for under the former system there was no difficulty in levelling up the various successive charges, so as not to leave spaces in the body of the coal in the retort. He believed the adoption of this machinery would in time become general.

Mr. J. West said he agreed with all that had been said as to the great benefit arising from the adoption of machinery in place of hand labor. He was anxious that some facts and figures should have been given as to the advantage to be derived in regard to the question of cost, but as this had recently been done by the President of the North British Association of Gas Managers (Mr. Alex. Wilson), he supposed Mr. Biggart did not think it was necessary. He also remarked that while the author of the paper said that stoking machinery had been in operation only a short time, it was actually in use 20 years ago. He (Mr. West) believed he had done more than anyone else in the invention of machinery for this purpose, and at Manchester coal breaking and elevating machinery had been in use since 1875. He was pleased to see that machinery had now been introduced in Glasgow. Reference had been made to the amount of manual labor required in charging and discharging retorts, and it was said that this gave an idea of the pressure that would be required. He had found that nearly all inventors had started out with making the machines too light, and as they proceeded they had to strengthen and increase the size of the various parts of the machinery.

Mr. J. Head remarked that the ingenuity displayed in the charging and discharging of retorts had been very much the effect of the labor troubles of some two or three years ago. This showed the tendency of these difficulties. Instead of contributing a greater amount for labor, which was the object of these difficulties from the workmen's side, they generally ended in machinery that cost less for labor, to the general benefit of the community. They were much obliged to Mr. Biggart, Mr. Foulis, and others who had managed to make such a very complete and effective plant. He would like to know whether Mr. Biggart had turned his attention to the substitution of electricity for hydraulic power in this kind of machinery. It seemed to him that this machinery had a resemblance to an overhead traveling crane, and in America electricity had in these cases very much taken the place of other mechanical appliances.

Mr. Biggart, in reply to the discussion, said that elevators and similar labor saving machinery had been long in use in the country meal mills, and the principle of the elevators now in use in gas works was the same, only the details were altered to suit the new kind of work. With regard to electric power this was a matter that had received attention. But the objection to such power was that they would require to introduce revolving machinery and shafts. After the members had passed through some of the business premises where electric power had been introduced, they would come to the conclusion that, of all kinds of machinery that should be adopted in retort houses, revolving machinery should be avoided. In the hydraulic machines the principle had been recognized that the moving parts should be reduced to a minimum, whereas with either air or electric motors there were an immense number of moving parts, and the cost of wear and tear was very high.

The President (Professor Kennedy), in moving a vote of thanks to Mr. Biggart for his paper, said he saw these machines some years ago, when they were in an early stage. He was very much struck with them then, and he had no doubt that in their latest form they would be still more interesting.

THE Selectmen of Rockport (Mass.) have granted a franchise to the promoters of the Rockport Gas Company, and it is said that construction work will be proceeded with immediately. The executive management of the Rockport Gas Company is: President, Jas. P. Merridew; Treasurer, Dr. Geo. A. Lowe; Clerk, Roger H. Tarr.

The Fixation of Atmospheric Nitrogen and the Manufacture of Cyanides and Ammonia.

[By Dr. Francis Wyatt, in *Engineering and Mining Journal.*].

The commercial production of cyanides and of ammonia from the nitrogen of the air has been the object of experimental research and study for the past fifty years, and is, without doubt, of the greatest importance to mankind. Theoretically and in the laboratory the problem has long been solved. If it has not been so hitherto industrially, and on the large scale, it is not only because of mechanical difficulties, but because experimenters have not properly understood the negative and unstable properties of nitrogen itself.

The progress of science has facilitated the combination of carbon, hydrogen and oxygen, independently of nature, and has taught us to build up from them, synthetically, many organic compounds identical with natural bodies. This may be illustrated by the synthesis of alcohol. If carbon is rendered incandescent by an electric arc, and hydrogen is passed between the poles, 61.100 heat units are absorbed, and acetylene is formed.

$$2C + 2H = C_2H_2$$

carbon + hydrogen = acetylene

If the acetylene be passed into an ammoniacal solution of cuprous chloride, it will form the red copper acetylide (Cu_2C_2), and this will produce ethylene or olefiant gas (C_2H_4) under the influence of nascent hydrogen given off by metallic zinc in a solution of ammonia. The olefiant gas, in its turn, can be combined with sulphuric acid to form sulphethylic acid ($C_2H_4 + H_2SO_4 = C_2H_5HSO_4$), and this, on being distilled with water, yields alcohol ($C_2H_5HSO_4 + H_2O = C_2H_6O + H_2SO_4$). By oxidizing the alcohol we obtain the aldehydes, or oxygenated essential oils; from these, by further oxidation, we procure a whole series of natural monobasic and polybasic organic acids, of which benzoic and oxalic may be taken as the respective types; and by finally combining the alcohols and the acids, we secure certain odoriferous ethers, characteristic of various fruits and natural fats.

In the case of free nitrogen, the combination with either or all of these elements is less easy because we encounter in it a greater natural lack of affinity and the general inertness under all ordinary conditions of temperature and pressure. In order to surmount the difficulties we must fulfill certain necessary thermal chemical and mechanical conditions. When these have been definitely established and complied with, we may expect that the most marvellous developments will immediately follow, because nitrogen is at once the most costly and the most essential component of all organized life.

All organic bodies can be made to part with their nitrogen in the form of ammonia! Why cannot we, therefore, with cheap and plentiful ammonia as the starting point, build up artificially and rapidly many substances of incalculable value which are in constant demand for the purposes of industry, and for the supply of which we are now entirely dependent on the diminishing reserves of nature and its slow processes of renewal? The question is not a hasty one, nor is there anything impossible or improbable in the hypothesis. Nitrogen (N) may be made to combine, on the small laboratory scale, with hydrogen (H) to form ammonia (NH_3) by the action of the silent electric discharge. Ammonia has been combined with carbonic oxychloride ($COCl_2$) to produce $CO(NH_2)_2$, which is in every respect identical with natural urea. It may also be oxidized and transformed into nitrates and nitric acid through the action of the nitrifying ferment ($2NH_3 + CaO + O_4 = Ca(NO_3)_2 + 3H_2O$), and $Ca(NO3)_2 + H_2SO_4 = 2HNO_3 + CaSO_4$) and by the action of nitric acid on benzine nitrobenzine is formed ($C_6H_6 + HNO_3 = C_6H_5(NO_2) + H_2O$), which is the basis of those practically innumerable and marvellous aniline colors now so generally consumed in the industry of dyeing and printing.

These general considerations, however, are as nothing when compared with two other important fields which would be benefited beyond the bounds of calculation by the cheap production of cyanides and ammonia from atmospheric nitrogen. The first and most interesting to mining engineers and metallurgists is in the treatment by the cyanide process, of those lean ores containing gold and silver which at the present time abound, which yet have no commercial value. The second, and most interesting to agriculturists, is in the restoration to the soil at a comparatively nominal cost of the nitrogenous element of fertilization which is yearly removed by the crops, and the actual loss of which has been estimated by Professor Alvord at $720,000,000 for this country alone. There is, then, a boundless demand for nitrogen which can never be satisfied from any source now known to us. It is true that there is an abundance of nitrates in Chile and Peru, but they are far too costly for general use, and as to ammonia, it is naturally too expensive, the whole of our present supply being derived from a small percentage of the total nitrogen contained in coals, either in the manufacture of coal gas or from the gases of the coke oven and the blast furnace. As to cyanides, we derive our supply from yellow prussiate of potash, and this is still made almost exclusively in the old-fashioned way by the fusion of such valuable organic matter as desiccated blood or horn with carbonate of potash and iron filings. In the face of these facts, and in view of the fascinating nature of the subject, I might well be excused for entering into minute details concerning the fixation of atmospheric nitrogen, but the chemical literature of the past few years is so pregnant with records of experiments and failures that I shall content myself with a very brief retrospective glance.

In the year 1845, Bunsen & Playfair, after an extended investigation, made up their minds that it was possible by means of high temperature to produce cyanides synthetically from a combination of carbon with nitrogen of the air. They were soon confirmed in this view by Reiken, who proceeded to make numerous experiments at varying temperatures, and who proved that cyanides can indeed be formed from the materials named when the furnace is at white heat. Other experimenters followed, and many attempts were made to build up a new industry, the most prominent being those by Possoz & Boissiere, who established a factory at Grenelle, near Paris, in 1843, and produced 15 tons of prussiate of potash of excellent quality as the result of their first year's work. The great cost of fuel and fire-brick at Paris, however, was a fatal obstacle to commercial success, and they were compelled to look for a more suitable location. In 1844. they made arrangements with Bramwell & Hughes to establish themselves near Newcastle-on-Tyne, and here they conducted their operations for more than two years. During this time they managed to produce about one ton a day of good prussiate of potash, but they were unable to make the work profitable, and, in 1847, they gave up the attempt. Their process, as I understand it, consisted in saturating small lumps of charcoal with about 30 per cent., by weight, of potash moistened with just sufficient water to dissolve it. After being dried, the mass was transferred to externally heated vertical retorts set in a suitable furnace heated to a white heat. The size of the retorts was approximately:

Inside diameter.....	19.69 inches.
Height heated to a white heat.....	9.84 inches.

A part of the combustion gases containing much nitrogen was heated to a white heat in a superheater, through which it was forced by a pump. At their exit from the superheater the gases entered the retorts through small slits in the side. After ten hours' exposure to the action of the heat and the gas the mixture of carbon and potash was withdrawn automatically and in regulated quantity from the bottom of the retort, a fresh supply being in like manner automatically fed into the top. The cyanized material, after passing through a cooling chamber, fell into a tank containing water and a native carbonate of iron. The mass fed into the retort appears to have lost about half its volume during the process, and is said to have contained on the average, when withdrawn, about 30 per cent. of its weight of cyanide of potassium (KCN).

For some years after Possoz & Boissiere abandoned their work nothing further seems to have been done, but in 1862, two other Frenchmen, Marguerite and Sourdeval, recorded another failure. The object of their process was to manufacture cyanide by passing nitrogen over a hot mixture of carbon and baryta, and to decompose the cyanide thus formed into ammonia by steam at 300° C., but no practical results came of their experiments. In 1868 the distinguished French chemist Berthelot discovered and made known to the world the synthesis of cyanogen from nitrogen and acetylene. In 1882, Ludwig Mond patented a method upon which he continued to work experimentally for several years. He, however, disregarded or ignored the discoveries of Berthelot, and worked on lines which only differed in certain mechanical details from those of Marguerite and Sourdeval, and he met with no better success than they did. To put it broadly, the chemistry of all these processes is now known to have been based upon the same fundamentally false notion of combining free nitrogen and fixed alkalized carbon in a furnace that was sought to be maintained at a constant white heat. The reactions that were expected to take place may be represented by the equation: $BaCO_3 + 4C + 2N = Ba(CN)_2 + 3CO$; and $Ba(CN)_2 + 4H_2O = 2NH_3 + Ba(HO)_2 + 2CO$.

To translate these figures into everyday language, it was assumed that 1,042 pounds of barium carbonate, 254 pounds of fixed carbon, and 149 pounds, or, say, 2,000 cubic feet, of gaseous nitrogen should produce 1,000 pounds of barium cyanide, and that this barium cyanide,

when treated with steam at 500° F., should produce 180 pounds of ammonia, the barium being continually recovered and used over again.

Since it is evident that these reactions only took place on a very limited scale, it is a necessary preliminary to inquire why all the processes failed. In my opinion it is because they made no provision for the most essential condition attendant upon the combination of nitrogen with carbon. I mean the condition that at least one of the two elements should be nascent, and endowed with the chemical energy pertaining to the nascent state. The first to realize this fact was Mr. Thomas B. Fogarty, of New York, one of the oldest, most persistent and painstaking of the experimenters in the manufacture of ammonia. In 1893 Mr. Fogarty announced that he had definitely abandoned the theory upon which he had hitherto been working; that he would make no further experiments with fixed carbon, and that he had adopted the use of hydrocarbons in order to obtain his carbon in the requisite condition. In July of the same year he took out a patent (Nos. 500,650 and 500,651) for his new process for making cyanides and ammonia, and as the results that he has been able to obtain from it have undeniably surpassed any of those formerly achieved, they give him a title to general consideration.

Fogarty now uses no fixed carbon for any purpose other than the manufacture of a highly superheated producer gas, consisting chiefly of oxides of carbon, free hydrogen and nitrogen. He passes this gas into and through a suitable retort, and simultaneously drives in with it in the same direction a measured volume of hydrocarbon vapor derived from burning fuel oil. The mixed gases come in contact with a measured quantity of incandescent and finely comminuted lime, which showers down from the top of the retort. His gas at this stage contains no free oxygen or carbonic acid, and the hycrocarbons are therefore ultimately decomposed into acetylene, free carbon and hydrogen, all of which may combine with nitrogen and the lime to produce calcium cyanide, and subsequently ammonia and fuel gas. As to the manner in which the combinations take place in Fogarty's furnace, I consider that they mainly depend upon, and are subservient to, the series of transformations or "crackings" undergone by the hydrocarbons at high temperatures, as, for example—

$2CH_4$ cracked up becomes $C_2H_2+H_2$
C_2H_6 " " $C_2H_4+H_2$
C_2H_4 " " $C_2H_2+H_2$

That acetylene is really produced there can be no doubt, and that this acetylene readily combines, at the temperature of its formation, with nitrogen and calcium, to form cyanides, is equally certain. I therefore believe that the reactions go on in the retort in two phases: First, a combination of the nitrogen and the earthy metal with acetylene; and, second, if the acetylene be further cracked up into nascent carbon and hydrogen ($C_2H_2=2C+2H$), a direct combination of the nascent carbon itself, with the nitrogen and the earthy metals, thus:

$$CaO + 3C \text{ (nascent)} + 2N = Ca(CN)_2 + CO.$$

The experimental operations which have been conducted under the new Fogarty process have justified this hypothesis and have developed some very interesting facts well worth recording. The most favorable temperature for the formation of cyanides is from 2,200° to 2,300° F. In seeking to maintain this temperature in Fogarty's furnace there was noticed a constant loss of heat, for which there was no apparent cause, and which it took considerable time and trouble to trace to its source. By carefully testing the gases at the commencement of a run it was ascertained that the temperature soon fell to between 1,700° and 1,800° F. This fall was always coincident with the appearance of small proportions of acetylene, doubtless due to the cracking of the hydrocarbons. At the end of some time the heat would go up to about 1,900° F., and at this point all trace of acetylene disappeared, although the atmosphere of the furnace showed no increase of free hydrogen or free carbon.

When means were devised to bring up the internal heat to between 2,200° and 2,300° F., the gases were found to contain large quantities of acetylene, and simultaneously cyanides were formed very plentifully. When the temperature was carried a little beyond this point, the acetylene was again reduced to a minimum quantity, but cyanides continued to be formed. This, therefore, is the crux of the Fogarty process. The whole secret lies in obtaining and maintaining a furnace temperature of about 2,300° F., with entire absence of free oxygen and carbonic acid gas, and in presence of an excess of free carbon. The fuels employed must be burned to carbon monoxide only, and ample provision must be made for the large amount of heat absorbed by the reactions, which, in the production of one short ton of calcium cyanide, I have calculated to be very approximately as follows:

Synthesis of cyanogen		1.815344 heat units.
Heating the hydrocarbon		.291076 "
Decomposing the hydrocarbon		.395540 "
Heating the lime		.398584 "
Decomposing the lime		.923252 "
Total heat absorbed		3.823896 heat units.
To be deducted—		
Produced by decomposing the oil gases	.316432	
Produced by formation of calcium cyanide	1.887252	2.203684 heat units.
Excess of heat absorbed		1.620212 heat units.

This shows that the heat absorbed by the chemical reactions involved in the production of 1 lb. of calcium cyanide amounts to about

$$\frac{1.620212}{2,000} = 810 \text{ B.T.U.}$$

At the outset of the experiments with Fogarty's process, it appeared as if the production of the necessary temperature, under the essential conditions I have emphasized, were an insuperable difficulty. The difficulty was, however, eventually surmounted, and the means by which it was overcome will be readily understood by those who are familiar with the workings of the modern blast furnace. The complete combustion of 1 lb. of fuel oil in air at 60° F. would produce about 14,500 absolute units of heat F. The products of combustion would provide the atmosphere most fatal to the desired reactions, and in avoiding this we sustain the heavy loss of heat (say 10,000 H. U.), entailed by oxidizing the carbon to its minimum only, and by neglecting the hydrogen altogether. The loss must be counterbalanced by superheating the air supply in which the oil is to be burned, and to show how this is possible, I take the composition of ordinary fuel oil ($C_7H_{14}O$), and calculate as follows:

Carbon, 84 per cent.; hydrogen, 14 per cent.; oxygen, 2 per cent.

The oxygen being too small to be taken into account, and the hydrogen being negligible because of the necessity for constant free carbon in the furnace, it is with the carbon only that we need to deal. The combustion of 1 lb. of carbon to carbon monoxide in air, of the mean temperature of 60° F., produces approximately 4,500 absolute units of heat Fahrenheit; and the carbon in our fuel oil will therefore produce $4,500 \times 0.84 = 3,780$ absolute heat units. This figure must be divided by the sum of the specific heats of the products of combustion and of the inert gases by which they are necessarily accompanied, these bodies being:

Carbon monoxide produced (CO)	1.96 lbs.
Free hydrogen produced (H)	0.14 "
Free nitrogen, taken in as air (N)	3.80 "

And their specific heat being—

CO. 1.96 lbs. × 0.245	0.580 heat units.
H. 0.14 lbs. × 3.410	0.477 "
N. 3.80 lbs. × 2.440	0.926 "
Total specific heat	1.983 heat units.

Then $\frac{3,780}{1.983} = 1,901°$ F., which is the absolute temperature of the burning gases inside the retort. This temperature of 1,901° F. is consequently the greatest heat obtainable by the use of normal atmospheric air, and the required heats for bringing about the sought-for reactions are only to be secured by burning the oil in air that has been previously sufficiently superheated.

The amount of normal air required for the combustion of the carbon in 1 lb. of our oil to carbon monoxide is 64 cubic feet, or say 4.92 lbs. by weight. The specific heat of dry air being 0.2375, there will be required $4.92 \times 0.2375 = 1.168$ heat units in order to raise its temperature through 1° F. From this we may calculate the number of heat units that may be absorbed by atmospheric air at 60° F., in acquiring any desired temperature—thus:

Air at 1,000° F. — 60 =	940°	× 1.168 =	1,090	heat units absorbed.
" 1,100° F. — 60 =	1,040°	× 1.168 =	1,214	" "
" 1,200° F. — 60 =	1,140°	× 1.168 =	1,331	" "
" 1,300° F. — 60 =	1,240°	× 1.168 =	1,448	" "
" 1,400° F. — 60 =	1,340°	× 1.168 =	1,565	" "
" 1,500° F. — 60 =	1,440°	× 1.168 =	1,682	" "
" 1,600° F. — 60 =	1,540°	× 1.168 =	1,799	" "
" 1,700° F. — 60 =	1,640°	× 1.168 =	1,905	" "

As I have shown that the combustion of the hydrocarbon in air at 60° F. produces 3,780 absolute heat units by the act of chemical combination,

I need hardly point out that since this absolute heat is produced independently of the actual temperature of the air, the total heat units produced in the furnace may be increased in direct proportion to the temperature to which the air is brought before it is introduced—thus:

Temperature of Air.	Heat Units in the Air.	Heat Units in Combustion Gases.	Absolute Heat Units in Mixture.
1,000° F.	1,090	3,780	4,870
1,100° F.	1,214	3,780	4,994
1,200° F.	1,331	3,780	5,111
1,300° F.	1,240	3,780	5,228
1,400° F.	1,565	3,780	5,345
1,500° F.	1,682	3,780	5,462
1,600° F.	1,799	3,780	5,579
1,700° F.	1,905	3,780	5,685

And in order to obtain the ultimate temperature which can be produced and maintained in the furnace, by oxidizing the carbon in our oil to its minimum in air heated to any desired degree, it is only necessary to divide the total absolute units of heat generated by the specific heat of the combustion gases—thus:

Air.	Combustion Gases.	Total Heat Units.	Sp. Heat of Products.	Highest Temperature Obtainable.
1,000° F.	3,780° F.	4,870	1.983	2,455° F.
1,100° F.	3,780° F.	4,994	1.983	2,519° F.
1,200° F.	3,780° F.	5,111	1.983	2,577° F.
1,300° F.	3,780° F.	5,228	1.983	2,636° F.
1,400° F.	3,780° F.	5,345	1.983	2,696° F.
1,500° F.	3,780° F.	5,462	1.983	2,754° F.
1,600° F.	3,780° F.	5,579	1.983	2,823° F.
1,700° F.	3,780° F.	5,685	1.983	2,867° F.

The question of heat being satisfactorily disposed of in this manner, I believe that the thermal and chemical conditions required by the new Fogarty process are well established. The remaining condition involves the construction and arrangement of certain mechanical details connected with the new furnace which is now about to be erected, and of these I do not feel competent to speak with authority. If the difficulties in this direction are successfully overcome, as it is claimed they easily can be, the production of cheap cyanides and ammonia from the fixation of atmospheric nitrogen will at once be placed upon an industrial and commercial basis, and chemistry will bind and place at our feet the hitherto least tractable of nature's elements.

Arc Lights and Illumination.

Mr. L. L. Summers, in discussing this subject in the current issue of *Electrical Engineering*, remarks that it is rather surprising that the subject of illumination is shrouded in the mystery it appears to possess to the general public. There appears to be a haziness regarding the definition of the terms candle power, illumination, quantity of light, brightness, etc. By illumination of a surface is meant the quantity of light received by it per unit of area. The candle power of a source of light in a particular direction is the intensity with which it radiates light in that direction, and usually varies with the path considered. The intensity of the light given off by a standard candle in the horizontal direction is taken as the unit of candle power. As the illumination varies inversely as the square of the distance, the actual illumination is dependent upon the distance and the illumination due to the horizontal rays of a candle at the distance of 1 foot is often taken as the unit of illumination and called a candle foot. The quantity of light received by a surface is the area of the surface multiplied by the candle power of the source divided by the square of the distance. If the source radiates light in all directions equally, so that the candle power is independent of the direction of the rays, the total quantity of light given out would be equal to the candle power of the source multiplied by 4π as the area of a sphere of unit radius is 4π or 12.56. Brightness is a term used in reference to the source of the light. For instance, a luminous surface has a brightness of 1 candle power per square foot when an area of 1 square foot of the surface acts like a lamp of 1 candle power in a direction normal to the surface. In applying these principles to the study of practical illuminants no serious difficulty is encountered so long as the standard of light and the source to be measured do not differ in color or temperature. When, however, an effort is made to measure the luminosity or light giving power of the arc lamp by means of an ordinary standard candle many difficulties are encountered.

Helmholz has said "that all effort to compare two sources of different colors is impossible." It is found also that all luminous rays, which make up the visible spectrum do not enter into the production of candle power in proportion to their energy. The most important rays as regards light giving power are those which form the yellow of the spectrum. Many observers make a distinction between the luminous intensity as measured by a photometer and what is often called the visual intensity—that is, the actual value as an illuminant. Where the sources of light are of the same color or temperature, the candle power and luminosity do not differ materially. Where the comparison is made of sources which differ in temperature, the indications of the photometer yield too low a value for the luminosity of the lamp of higher incandescence. Professor Nichols has estimated for the electric arc that the ratio of candle power to total luminosity is about 4 to 5. Blondel, in a paper before the Electrical Congress, states that, "Generally speaking, an arc light of 'so many candles' has no definite meaning, for it does not intimate to what absolute value of illumination that measure refers, nor with what standard it is obtained." In addition to the criticism as to the application of the term candle power to arc lamps, there was at one time a tendency to compare the lamps by their mean spherical candle power. Incandescent lamps are usually rated by mean spherical candle power, but the difference between the mean horizontal and mean spherical is not very great. This relation practically remains constant for a given type of lamp, and, according to the Franklin Institute tests, the ratio of the mean spherical intensity to the *mean* horizontal varied from eight-tenths to nine-tenths, according to the style of the lamp, being eight-tenths for the Edison and nine tenths for the Weston. The ratio of the mean spherical candle power to the horizontal intensity in the plane of the filament varied from nine-tenths in the case of the Edison lamp to about one in the Weston. The ratio of the mean spherical candle power to the maximum or mean horizontal candle power in the case of the arc lamp varies far more widely. In a recent work on photometry by M. Palaz, regarding the mean spherical intensity, the author says: "In what precedes no attention has been paid to mean spherical intensity. Up to the present too great value has been given to this element, which only plays a very small part in problems of illumination by bare arc lamps. The most important element in the arc lamp is the maximum intensity. A knowledge of the horizontal and maximum intensity easily permits the calculations of the intensity for a given inclination, and it is the latter which should be employed in calculating the illumination at a given point. The mean spherical intensity should not be employed in calculating illumination instead of the effective intensity for the inclination considered."

This has long since become the accustomed method of practically considering arc lamps, and while at one time there was a hue and cry against rating lamps by what is known as their nominal candle power, this relation gives a means of determining approximately all other values. Professor Nichols has said "the electric arc stands quite alone for the purpose to which it is adapted, and need fear no rivals. It does not need to be estimated upon any fictitious basis, and the continuance of the pernicious practice of ascribing to it powers of illumination which it does not possess must, in a great measure, be charged to the account of the standard candle; for with the best intentions in the world the comparison of sources of light differing so widely in color as the candle and the electric arc is nothing more than a rude approximation, leading by its very inaccuracy to the temptation of the grossest exaggeration."

It is evident that many of the statements regarding the candle power of arc lamps and the comparative values of the arc and incandescent light as sources of illumination are very conflicting and often erroneous. In "Maler's Arc and Glow Lamps" it is stated that tests at the International Health Exhibition, in London, in 1884, showed that the average candles per horse power was 1,440 in case of the arc lamp, while only 175 candles in case of the incandescent. Nichols gives the efficiency of the arc lamp as from one and one-half to three times that of the incandescent, the comparison being based upon mean spherical candle power.

Perhaps the most reliable, complete and accessible tests are those given in M. Palaz's recent work on photometry. Rosseau's tests at the Antwerp Exposition were conducted upon 24 different styles of lamp. For the purpose of comparison we may take one lamp burning at 45.5 volts and 10.8 amperes, or consuming 491 watts. The values in the tables are given in carcels. Calling one English standard candle equal to 9.5 carcels, the horizontal intensity of this lamp was 532-candle power. The maximum was 2,622-candle power, and the mean spherical 950-candle power. In another lamp consuming 6 amperes at 47.1 volts, or 262 watts, the horizontal candle power was 314, the maximum was 969, and the mean spherical 332.

The ordinary formula for obtaining the mean spherical candle power

from the horizontal and maximum is to add one-half the horizontal candle power to one-fourth the maximum candle power, the value being the mean spherical. From Rosseau's test the horizontal candle power is shown to be about .2 the maximum, so that the mean spherical can very readily be obtained approximately by multiplying the maximum by .35; in other words, the mean spherical candle power is equal to about .35 of the maximum candle power. It is evident that a comparison between the mean spherical candle power of the incandescent and arc lamp is of little value. In the arc lamp only the lower hemisphere at most would be used, and the illumination for practical purposes should be computed for this area and not for the whole sphere. The mean spherical candle power is only .35 of the maximum, while in the incandescent lamp it is from .8 to .9. Furthermore, the ordinary measurement of candle power of an arc lamp represents only 75 to 80 per cent. of its actual luminosity.

A considerable amount of space has been devoted to these considerations, as at a recent meeting of an electrical association we were very much surprised to hear a member, presumably possessing some scientific knowledge of the subject, attempt to compare the *practical* illuminating values of an arc light to an incandescent light, on the basis of mean spherical candle power.

The Scotch Shale Oil Industry.

Engineering, in reviewing the status of this industry, says that the unexpected fall in the oil production of the United States is known to be due to natural causes, and not to a market rig, as was very generally supposed at the time, has had at least one good effect in the increased activity which it has caused in the shale oil districts of the north. Instead of having to face a constantly falling market, as they have done for so many years, the shale distillers have some time since been enabled to raise the price of paraffine wax, and recently to nearly double the price of their oil. For some time to come, the only probability of a fall in the value of the latter depends on the Russian producers, who, however, produce no paraffine wax from their oil, and who have constantly before them the fear that their great center at Batoum, from which they now export enormous quantities of kerosene, may at any time be taken from them to form a strategic position for the Russian Navy.

Probably no industry can show so excellent a record of triumph of engineering skill and scientific knowledge over commercial depression as that of shale distillation. Brought into being by Dr. James Young, of Renfrewshire, in the early forties, it soon acquired enormous importance, and the process was even worked under royalty in the United States, where at the middle of the century, there were between 50 and 60 coal and shale distilleries. All the Scotch companies, as well as those of the States, were at the height of their prosperity when the oil boom of the latter country introduced almost unlimited supplies of a natural oil which corresponded with the crude oil obtained by distillation, and which, like it, only required to be refined to render it marketable. On the one side, there was the cost of mining the shale and of distilling it; and, on the other, the sinking of an artesian well, from which the oil flowed like water.

The shale distilleries of the United States were almost immediately dismantled or converted into refineries for petroleum, but the canny Scot, unwilling to abandon the capital already sunk, stuck to his guns, and, although only two of the companies, including, happily, the pioneer company, have maintained a satisfactory position, it is certain that more than one of the moribund companies will now, at least for a time, be able to continue work with the probability of a return of a considerable share of prosperity. The amount of shale distilled during the year 1894 was 1,986,383 tons, of which Linlithgowshire supplied no less than 1,168,488 tons; and the oil obtained amounted to 47,693,458 gallons, as against 45,725,841 gallons in 1893, and 44,238,280 gallons in 1892. This comparatively small yield is explained by the fact that the shale distilled usually contains about 73 per cent. of mineral matters which yield no oil. The shale treated consists mainly of a bituminous shale, or indurated clay, belonging to the coal measures, but its composition is entirely different from that of the coal, and the product of the distillation bears but little resemblance to coal oil.

The products which have probably most contributed to the continued existence of the industry, are the paraffine wax and the sulphate of ammonia which are obtained from the shale. The value of the former factor has been largely discounted by the output of the United States refineries, but the ammonia is produced only from shale, and the fluctuations in its price have very largely decided the question as to whether the year's trading should show a profit or a loss. No less than 60 lb. or 70 lb. of the sulphate per ton is yielded by some shales.

The crude oil obtained from shale corresponds closely with natural crude petroleum, and is converted into marketable products by very similar methods of distillation and chemical treatment; the principal difference lies in the higher density of the lamp oil obtained from shale and the higher "flash point" possessed by it—*i. e.*, the temperature at which it evolves an inflammable vapor. It is this latter property which caused the Scotch producers to identify themselves with the agitation which has for some time been carried on, to raise the standard fixed in this country as the limit of safety for illuminating oil.

As the price of oil has fallen, the shale distillers have improved the retorts and stills to an extent which has resulted in the reduction of the cost of the production of the finished oil to 5 cents per gallon, about one-sixth of the cost of thirty years ago. Successive patents by Young, alone and in conjunction with Beilby, and by Henderson, whose latest retort appears likely to reduce the cost of production more than any other of the many which have been introduced, have brought about this result. One cannot but admire the dogged determination and enterprise which, year by year, have caused the accounts of the Scotch companies that are still working, to show a saving on working expenses which has practically neutralized the loss from falling prices, and which may result in the complete resuscitation of an industry that, until now, has appeared ever tending towards extinction.

Wirt's Gas Manufacturing Apparatus.

On August 6th U. S. Letters Patent (No. 544,151) were granted to Mr. Reuben D. Wirt, of Independence, Mo., for useful improvements in gas manufacturing apparatus. Using the words of the specification:

My invention relates to gas manufacturing apparatus, and more particularly to an apparatus for producing either a water or fuel gas or an illuminating gas, or a mixed gas composed of both fuel and illuminating gas.

All the plants for manufacturing gas now in use in small towns, as far as my knowledge extends, produce about 5,000 cubic feet of gas per hour. As towns of small size, containing, say, a few thousand inhabitants, use only from 5,000 to 15,000 feet of gas per day, it is manifest that after running for two or three hours the manufacture of gas for the day must cease and the furnace fire be extinguished or permitted to die out, as keeping up the fire would be an unnecessary expense of fuel and labor. It is also manifest that the rebuilding of the furnace fire each day is a very expensive operation, all things considered. My object is to obviate this unnecessary expense of fuel and labor, and that I accomplish this object will be apparent from the following description.

The features of novelty in my apparatus are pointed out in the appended claim. In order that the invention may be fully understood, reference is to be had to the accompanying drawings, in which Fig. 1 represents a front elevation of a gas manufacturing apparatus embodying my invention, and Fig. 2 is a vertical longitudinal section of the same.

In the said drawings 1 designates the gas generating furnace, which is provided with a chamber divided by a grate 2 into a generating chamber 3 and an ashpit 4. Openings 5 and 6 in the front wall of the furnace communicate with the generating chamber, and are controlled by the doors 7, of the ordinary or any preferred construction. A similar door closes the opening 8 communicating with the ashpit 4. A shield 9, of firebrick or any other suitable material, bridges the space horizontally between the front wall of the furnace and the upper end of the bridge wall 10. A similar wall 11 is disposed about centrally between the wall 10 and the rear wall of the furnace, so as to form the fixing chambers 12 and 13, in which is arranged in the usual manner brick checkerwork or other mass of refractory material. The upper end of the chamber 13 communicates with the vertical flue or chimney 14, which is closed at its upper end by a weighted lid 15, and projecting from said lid is a handle 16, by which it is opened when necessary. Extending longitudinally of the furnace and resting upon the shield 9, the bridge wall 10, and the bridge wall 11, and also projecting at its rear end over the fixing chamber 13 and at its front end through the front wall of the furnace, is a retort 17, and this retort 17 is inclosed at its upper side by an arch 18, so as to form the intervening space 19, which communicates with the chambers 3 and 12, so that the products of combustion and the products of decomposition, as hereinafter referred to, will pass circumferentially and spirally around said retort from the chamber 3 to the chambers 12. The front end of the retort is closed by the door 7, of any suitable construction. To afford communication betweeen the

Fig. 1.

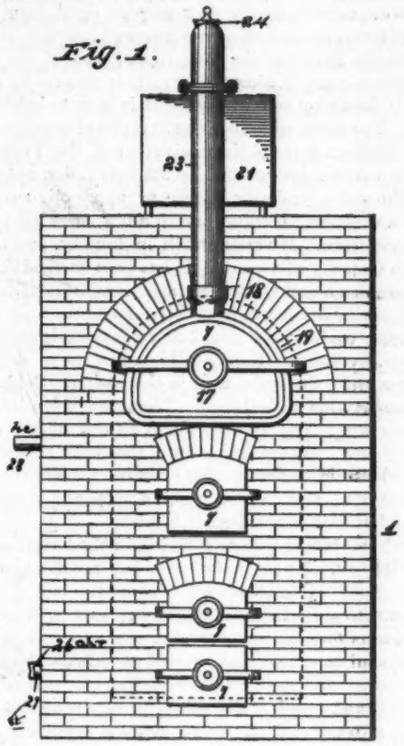
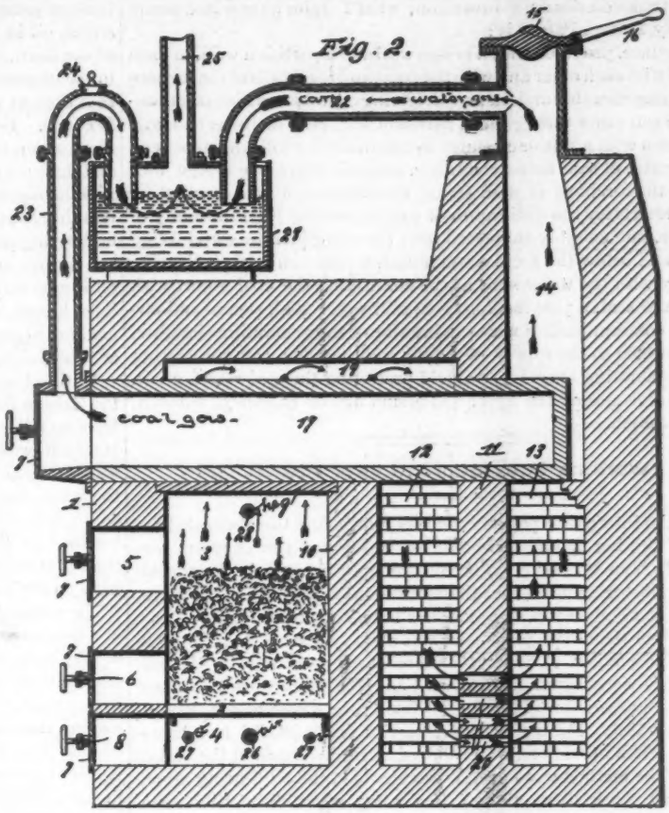


Fig. 2.



chambers 12 and 13, the partition 11 is provided with a series of passages 20 near its lower end. Mounted upon the furnace at any suitable point is a water seal 21, and connecting said water seal with the flue or chimney 14 is a pipe 22. A pipe 23 also connects the retort 17 with said water seal, and is provided with an opening to give access to the interior of the pipe to remove stoppages etc. A cap 24 normally closes said opening. A pipe 25 communicates with the water seal at one end and is connected to a holder (not shown) at its opposite end. Communicating with the ashpit below the grate is the end of an air-blast pipe 26, and communicating also with said chamber are the ends of the steam pipes 27, and communicating with the chamber 3 above the fuel is a pipe 28, which serves for the introduction within the said chamber of a liquid hydrocarbon, or an oil supply pipe may communicate with the fixing chambers.

Before proceeding further it is to be noted that I have produced what I term a "low-down furnace"—that is, a furnace which is only one story high—so that the retort 17 is within convenient reach of a person upon the ground, and at the same time the fixing chambers are of sufficient length to properly decompose the constituents employed and form a fixed or permanent gas. It will also be noticed that by this arrangement a more extended heating surface upon the retort is obtained and requires no special furnace blocks in its construction.

As it is practically impossible to manufacture what is known as "water gas" with a bituminous coal, as the smoke and soot would soon choke up or close the checkerwork fixing chambers, and as it is altogether too expensive in the Western States to employ hard coal, I employ one or more retorts 17, wherein I continuously distill bituminous coal in the ordinary form used in coal gas works, and employ the resultant coke in the furnace.

In operation I first place within the retorts 17 a suitable quantity of bituminous coal, and then build a fire upon the grate. I then raise the weighted lid 15 and open the valve (not shown) controlling the air-blast to allow the same to pass up through the burning fuel, around the retort, down through the chamber 12, up through the chamber 13, and out of the flue or chimney 14 at its upper end. This blast is kept up until the checkerwork of refractory material within the fixing chambers is heated to incandescence. This hot blast blowing upon the retort throughout nearly its entire length also begins the distillation of the coal therein, and the coal gas thus formed, which possesses illuminating power in a high degree, escapes through the pipe 23 and enters the water seal. I then cut off the blast and close the lid 15, which is weighted, so that it is airtight and cannot be accidentally opened, and open the valves (not shown) to permit the steam to enter the ashpit 4 and pass up through the chamber 3, where, owing to the intense heat radiating from the incandescent carbon, it begins to decompose and passes spirally around the retort 17, where the distillation operation of the coal within the retort continues, and thence, passing down and up through the highly heated refractory material of the chambers 12 and 13, is thoroughly decomposed and transformed into a fixed or permanent water gas, which passes up through the flue or chimney 14 and through the pipe 22 into the water seal 21, where it mixes with the coal gas from the retort. The purified gas, possessing in a high degree illuminating and heating power, then proceeds to the holder by way of the pipe 25.

If it is desired to form a hydrocarbon gas possessing both illuminating and heating power, the valve (not shown) is properly operated to permit liquid hydrocarbon in sufficient quantities to enter the generating chamber 3 above the grate, where it is vaporized and passes with the water gas around the retort and into the fixing chambers, where it is thoroughly and effectually decomposed and emerges as a fixed or permanent carbureted hydrogen gas.

In the manufacture of gas, as the coal becomes coked in the retort and as the fire must be replenished with fuel, the door 7 of the retort is opened and the coke extracted and fed into the furnace. It is manifest, therefore, that after the first retort full of coal is distilled, if properly attended to, it will never be necessary to burn a second quantity of bituminous coal in the generating chamber, because the coke will be employed for that purpose. It is also manifest that with a furnace of this character in a small town the apparatus will be run at less than its capacity, and the gas generated slowly with comparatively a small quantity of fuel. In fact, it is my intention to occupy a whole day in generating the proper supply of gas, and then at night charge the retort to its fullest extent with coal, which, by reason of the incandescent material and the heat and what fire there is upon the grate, will be distilled by morning and reduced to coke at a white heat, which will be transferred to the generating chamber to begin the new day's work.

From the above description it will be apparent that I have produced an apparatus for manufacturing gas which is comparatively simple and cheap of construction, which can be operated at small cost, and wherein nearly the entire surface of the retort is exposed to the action of the products of combustion and of the products of decomposition, so that the coal within said retort will be thoroughly and quickly coked.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

A gas furnace, provided with a bridge wall and a partition wall, to form conjointly with each other and with the front and rear walls of the furnace the generating chamber and the parallel fixing chambers, which communicate with each other through said partition wall near its lower end, and provided also with a flue or chimney communicating with the upper end of the rearmost of said fixing chambers, an arch above the bridge wall and above the foremost of said fixing chambers and said generating chamber, retorts for the distillation of coal extending longitudinally of the furnace, and suitably supported over the said generating and fixing chambers and below the arch, a water seal, a pipe connecting the flue or chimney with the water seal, a pipe connecting the coal retort with the said water seal, a pipe leading from said water seal, steam and air-blast pipes communicating with the interior of the generating chamber, a pipe connected to the supply of liquid hydrocarbon communicating with said generating chamber, a shield protecting the coal retort, and a weighted valve closing the upper end of said flue or chimney, substantially as set forth.

Working Petroleum in Lower Alsace.

Among the interesting papers read this year before the Federated Institution of Mining Engineers should be mentioned the chapters prepared Dr. L. Van Werveke, on petroleum development in Lower Alsace. The Doctor explains that the bituminous spring of Pechelbronn, to which that village owes its name, has been known for many centuries, and indeed the use of petroleum was already termed "ancient" in 1498 by Wimpfeling. The first underground workings in the oil-bearing sands were begun in 1742, and in 1768 these workings came into exclusive possession of the Le Bel family, in whose hands they remained until 1888. Mining had gone on to a depth of 296 feet below the surface when operations were stopped at Pechelbronn at the end of that year. The method was to put down shafts to the oil-bearing layers of sand and work these along; but when great difficulties arose through outbursts of oil and gas and the inrush of water, parallel levels were driven in the "hanging wall."

Ten larger deposits and a great number of smaller ones, worked from 11 different shafts, represent the sum total of the old mining industry of Pechelbronn. Besides the oil which oozed naturally from the sand, the sands themselves were collected, and about 4 per cent. of crude oil was extracted from them by evaporation. Boring operations up to the year 1880 were only carried out to determine the direction of the trial levels, which had to be driven above the oil deposit. But since that year they have assumed continuously growing importance, and now in the Pechelbronn oil field alone more than 500 boreholes have been put down. Mining Councillor Jasper has given full details of the results of these borings. The oil deposits which have been thereby proved occurred at five different horizons, at the respective depths of 262–295 feet, 394–492 feet, 590–656 feet, 754 feet and 1,098 feet. The results of the borings vary considerably; about 23, or 4 per cent. of the whole number, have struck natural wells wherein the gaseous pressure is sufficient to spurt the oil out at the surface with considerable force. One great advantage of the Lower Alsace oil wells is that the oil in them is mixed with comparatively little water. At Sulz and Wald petroleum was got in the 18th century, just as at Pechelbronn, but their mining operations have been long suspended. At Schwabweiler (3¼ miles southeast of Pechelbronn) search was first made for petroleum about 1830, and a mining concession was granted by the King of the French in 1841; workings were carried on till 1883 by means of shafts reaching to a depth of 230 feet. Fifty trial borings put down in the neighborhood of the workings at depths varying between 260 and 295 feet, had given unsatisfactory results. The petroleum bearing sands of Schwabweiler do not form long, narrow bands, as at Pechelbronn, but spread over large areas in deposits having a maximum thickness of 6 or 7 feet. The dip of the beds is steeper, and small faults are numerous. Simultaneously with the greater extension of the boring operations at Pechelbronn the exploration of the areas lying outside of the then known oil field was pushed forward, the greatest activity in this direction being shown in the year 1890, when, as a result of the experimental borings, no less than 346 leases were granted. The occurrence of petroleum in Lower Alsace was proved in districts extending far beyond the Schwabweiler-Pechelbronn area, not only in tertiary rocks but also in the mesozoic strata of the Zabern fault area.

In 1892 only two further leases were applied for, and in the annual report of the district governor of Lower Alsace for 1893 it is stated that the proposed heavy increases in taxation have deterred applicants for further petroleum leases. The average depth at which the borings struck oil in the tertiary area was 256½ feet. Curiously enough, south of the Zorn, where the actual average is only 134½ feet, the oil bearing lower oligocene strata occur actually at a greater depth from the surface than at Pechelbronn (where oil is not generally struck till about 294 feet). Between the Zorn and the Moder, and east of the tertiary dislocation, the older tertiary is almost everywhere covered by pliocéne and drift; where it does crop out in places it is seen to belong to the middle oligocene. For these and other stratigraphical reasons one infers that south of the Zorn it is not the equivalent of the Pechelbronn oil bearing strata which has been struck by the bore holes, but an horizon higher up in the series, probably middle or upper oligocene. The oil is generally of a dark brown color, and in a few cases light yellow, light brown, or dark green. It varies much in fluidity, and in places assumes almost the viscosity of asphalt. It has been worked since 1880 at Biblisheim, Durrenbach and Ohlungen (district of Oberstritten).

Within the same period 212 leases have been recognized as valid in the Zabern fault area; oil has been struck at various horizons from the trias up to the oolite, inclusive. It generally comes up in drops of a blackish-brown color with the water used in the boring. Seldom does asphalt occur in conjunction with the oil. The average depth at which the latter was struck was 82 feet, or only about a third of the average depth in the tertiary area. At the first glance, therefore, one would be inclined to think that the Zabern oil field is more favorably situated than that of Pechelbronn, and yet no regular winnings of petroleum have so far been undertaken in the former district.

The greatest depth yet reached by any boring in the tertiaries is that of Oberstritten—2,034 feet. No oil was struck, but proof was obtained of a hitherto unimagined thickness of oligocene marls, and interesting observations were made on the increase of temperature with depth below surface. Daubree here makes a mistake, due to an error, in declaring that the thermal interval or number of meters for the increase of each degree diminishes in the direct ratio of the increase of depth. A circumstance worthy of notice is the frequent occurrence of the oil in association with mineral waters, which contain generally a high percentage of bromides. These waters, however, are often found to occur alone, and their saline content is very variable.

The last point to which particular attention may be directed concerns the relations of the respective borings one to the other. Of great importance in this connection are the three borings, Nos. 146, 186 and 213, in the neighborhood of Pechelbronn. At approximately identical depths, namely 443, 452 and 459 feet, they have yielded abundant springs of water and oil of the same character. There is no doubt whatever that these are derived from one and the same deposit, and a line drawn through the three borings exactly corresponds to the average strike of the sands formerly worked at Pechelbronn. There is a similar correspondence in the case of the line connecting spring No. 344 on the northern edge of the Hagenau Forest with spring No. 346 at Surburg. One sees then that the deposits tapped by boring have the same strike as those which were formerly worked by mining, and in continuing exploration work this parallelism should be borne in mind. In 1885 Bergrath Jasper first drew attention to this general coincidence of strike, but he made it run too much easterly. In view of the above-mentioned dependence of the respective borings, it will be seen that rich springs may be suddenly dried up by the putting down of new search holes. This occurred, for instance, in the case of boring No. 334, which drained No. 337 in the same, and No. 9 in a neighboring property. The production of crude oil from Lower Alsace in 1894 was 15,632 metric tons; the refined petroleum produced amounts to 4,000 metric tons per annum, or 1.3 per cent. of the consumption of Germany. The yearly imports into the German Empire from America average 250,000 tons, and from Russia 50 tons.

Tall Chimneys—Their Advantages, Economical and Sanitary.

Mr. Barnet le Van believes that the coronet theory of chimney construction to the end of permitting the use of the cheapest quality of coal, while at the same time effecting its complete combustion, is not fully understood by many of even the most experienced scientists; or, if understood theoretically, the theory is departed from or ignored in practice. The economic requirements of the present demand the employment of low grade fuel in our large manufacturing and industrial establishments, but to meet this demand and justify the use of such low priced fuel, it is obvious that the economy realized in its purchase must be maintained in its consumption.

To realize this high chimneys are requisite. When a number of

boilers are connected to one chimney the area of the draught chamber is not required to be so large as that of the sum of several chimneys used for single boilers, since the friction becomes reduced and the draught is steadier when several boilers are fired successively and a higher temperature is maintained.

Engineers usually consider that the larger the area of the chimney the better the draught; but this is not the case with high chimneys, since the gases can cool down too rapidly in one of large sectional area. It has, in fact, been found that when a chimney is very large compared with the number of boilers connected with it, or for the quantity of coal burnt, as in the case of a chimney built and adapted for the addition of boilers from time to time, the draught is improved and a higher temperature maintained as the additional boilers are subsequently connected with it.

A chimney suitable for wood, bituminous or anthracite coal would not burn to an advantage the cheap coals now so universally used, such as "pea," "buckwheat," "rice," "barley," "slack" and culm," unless designed so as to be especially adapted to the latter kinds of fuel. Hence it is well to err on the safe side by building high chimneys of less cross section, as an excess of draught can be easily regulated. For economy the temperature of the chimney is limited, especially for the cheap fuels now used; therefore the temperature should be kept below 450°. The efficiency of chimneys is difficult to analyze, as the elements are very variable, chimneys often doing better on a calm, rainy day than on a windy day.

The influence of external temperature and of the barometric pressure on the rate of combustion cannot well be estimated. An increasing density of the external air favors combustion by increasing the draught, and also because a less volume of cooler air is necessary to burn one pound of combustible. The draught of chimneys is thus rendered more active in winter than in summer. The influence of the moisture in the atmosphere is often important. In proportion as the moisture in the air increases the fire slackens, especially with feeble pressure. A dry, cold air, with high barometer, is therefore more favorable to combustion.

In order that no loss shall occur, it is necessary that the heated gases should always enter the chimney with the least practical temperature. Upon the velocity of the draught depends the proper thickness of coal upon the grate; for if the draught be very strong and the fire thin, a great deal of unconsumed oxygen will escape up through the fire and a needless cooling of the contents of the flues will be occasioned; whereas if the fire be thick and the draught sluggish, much useful effect of the coal will be lost by the formation of carbonic oxide (CO) in place of carbonic acid (CO_2).

In building a chimney an excess of height, as already mentioned, should be chosen, since the draught, if too strong, can be regulated by a damper. In all cases in which the draught is produced by simple "chimney draught," the chimney performs the function of a machine, and its dimensions, height and cross section taken in connection with the area of the fire grate, and the surface of the fuel exposed to the action of the air, are the principal elements on which not only complete or perfect combustion, but the quantity of fuel burned in a given time depend. The determination of the proper proportions between the heating and the fire grate surface depends on the initial temperature of the gases, and as the initial temperature varies with the rate of combustion, or the height of the chimney, this indirectly enters into the consideration of its proportions. The efficiency of high iron or steel chimneys over that of brick chimneys of the same area of cross section is no doubt due to the leakage of air through the porous brickwork of the latter; the factor of radiation of iron chimneys does not count, as it hardly has time to act because of the velocity of ascentional current of heated air and other gases in the chimney, which in some cases reaches 50 miles an hour.

In the last few years there has been a tendency to go back to the use of artificial draught, induced or forced by a fan or blower, the main plea being that by the use of an "economizer" in the chimney flue the boiler would be more economical. This, no doubt, is true where inferior boilers are used. The adoption of a first-class boiler, properly set in brickwork, connected to a high chimney, renders the use of an economizer unnecessary. The cost of fans or blowers, and the wear and tear of them and the boiler, far exceeds the extra cost of a high and properly constructed chimney.

Large power stations in cities, with low chimneys, discharge their noxious gases and unburnt carbon in the lower strata of air currents, and these are wafted into dwellings to the detriment of health and cleanliness, especially when bituminous and cheap anthracite coals are used, as is the case of large power plants of modern times.

From a sanitary point of view also a high chimney is desirable. The city of Carlisle has its sewers ventilated by about 30 chimneys belonging to the different factories. One of these chimneys is 300 feet high, having an air velocity through it of 50 miles per hour, the air pressure at its base being capable of sustaining a column of water 1¼ inches in height. The ventilation caused by this chimney is perceptible for a radius of 1,200 feet—equal to an area of over 103 acres.

There are great advantages to be derived from the use of high chimneys, especially in large cities. The legislative department of large cities should pass ordinances encouraging the erection of high chimneys by agreeing to pay part of the expense when chimneys are proposed to be erected, say, to a height of 250 feet or over. In such cases the city, of course, should reserve the right to connect the sewers to such chimneys for the purposes of ventilation. By so doing the sanitary condition of the city would be greatly improved at a very slight cost, and the power plant could use the cheapest fuel obtainable, both the community and the manufacturer accordingly being the gainer.

Theoretically the best form or shape of the cross section of a chimney is circular, and for iron no doubt it is the cheapest; but experiments in conveying both water and air have shown that square flumes for water and square brick chimneys give better results than did circular conduits of equivalent area. The above experiments were made by the late John William Nystrom and the writer in 1880, and the explanation arrived at was that gases and water assume a circular or whirling motion, causing a layer of stationary gas on gas or water on water was less than that of the enveloping material, which only acted on a narrow line at four points in a square chimney, the resultant friction was less than that in a round chimney, which is supposed to be reduced in diameter at least 4 inches by a layer of gas stationary, of 2 inches around the envelope; but under any circumstances the difference is only about 2 per cent.

Chimneys of large area constructed of iron, as stated above, are the cheapest to build; if built of brick they should be square inside and round on the outside, as the latter form presents the least surface to the air and the wind resistance is less.

Electrical Items Worth Remembering.

Dropping a steel magnet, or vibrating it in other ways, diminishes its magnetism.

It is said that steel containing 12 per cent. of manganese cannot be magnetized.

Flames and currents of very hot air are good conductors of electricity. An electrified body, placed near a flame, soon loses its charge.

In charging a secondary battery, the charging electromotive force should not exceed the electromotive force of the battery more than 5 per cent.

Lightning has an electromotive force of 3,500,000 volts and a current of 14,000,000 amperes. The duration of the discharge of lightning is $\frac{1}{10000}$ of a second.

The resistance of copper rises about 0.21 per cent. for each degree Fahrenheit, or about 0.38 for each degree Centigrade.

A lightning rod is the seat of a continuous current, so long as the earth at its base and the air at its apex are of different potentials.

The rate of transmission on Atlantic cables is 18 words of 5 letters each per minute. With the "duplex" this rate of transmission is nearly doubled.

The effect of age and of strong currents on German silver is to render it brittle. A similar change takes place in an alloy of gold and silver.

To obtain the number of turns of wire in an electro-magnet, multiply the thickness of the coils by the length, and divide by the diameter of the wire squared.

A test for the porosity of porous cells consists in filling the cell with clean water and taking the per cent. of leakage. The correct amount of leakage is 15 per cent. in 24 hours.

If the air had been as good a conductor of electricity as copper, says Professor Alfred Daniell, we would probably never have known anything about electricity, for our attention would never have been directed to any electrical phenomena.

A perfect vacuum is a perfect insulator. It is possible to exhaust a tube so perfectly that no electric machine can send a spark through the vacuous space, even when the space is only one centimeter.

For resistance coils, for moderately heavy currents, hoop iron, bent into zigzag shape, answers very well. One yard of hoop iron, ¼ inch wide and 1 32 inch thick, measures about 1-100 of an ohm; consequently, 100 yards will be required to measure an ohm.

The voltage of a secondary battery must always be equal to or slightly

in excess of the voltage of the lamp to be burned. For example, a 20-volt lamp will require 10 secondary cells, but 10 cells will supply more than 20 lamps.

Compression of air increases its dielectric strength. Cailletet found that dry air compressed to a pressure of 40 or 50 atmospheres resisted the passage through it of a spark from a powerful induction coil, while the discharge points were only 0.05 centimeter apart.

An accumulator with 17 plates, 10 by 12 inches, is reckoned in horse power hours, equal to about 1-horse power hour. Taking this as a basis, it will require 6 cells for 1-horse power for 6 hours, or 30 cells for 5-horse power for the same length of time.

To obtain the length of wire on an electro magnet, add the thickness of the coils to the diameter of the core outside of the insulation, multiply by 3.14, again by the length, and again by the thickness of the coils, and divide by the diameter of the wire squared.

Blotting paper, saturated with a solution of iodide potassium to which a little starch paste has been added, forms a chemical test paper for testing weak currents. When the paper (slightly damp) is placed between the terminals of a battery, a blue stain appears at the anode, or wire connected with the carbon or positive pole of the battery.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. Henry H. Hall, as Trustee, has instituted a suit against the Ashtabula (O.) Gas Light Company to foreclose a mortgage on that plant.

Mr. Chas. Williams, a well known resident of Terre Haute, Ind., died at his home in that city about a fortnight ago. His property, which amounted in value to perhaps $100,000, was disposed of by will; and one of the beneficiaries thereunder is Mr. M. N. Diall, Superintendent of the Terre Haute Gas Light Company, who receives $10,000.

The following breezy news comes from Findlay, Ohio, under date of August 16th: "The city gas management, always a prolific subject for fault finding, has again set everybody by the ears by adopting a new schedule of gas rates, to go into effect October 1st. The old rates have been doubled, and gas by the meter measurement will hereafter be charged 20 cents per 1,000 cubic feet. Stoves where no meter is used will be charged $3.20 per month. The people are up in arms, and many who have been using gas for fuel will discontinue the practice. The Gas Trustees, after partially contracting with Col. A. H. Moore, of New York, to put in the Williams process of manufacturing fuel gas, at a cost of $7,000 for an experimental plant, have rescinded their action and made a contract with the W. J. McClurg Construction Company, of Pittsburg, Pa., for the erection of a plant to make artificial gas. The contract price is $89,337, exclusive of the buildings, and it is guaranteed that gas can be produced at a cost not exceeding 8½ cents per 1,000 cubic feet."

The plant and franchises of the Columbia (Mo.) Gas Light and Coke Company were recently sold, per order of Mr. Chas. Parsons, Trustee. The purchaser was Mr. Sylvester Watts, who has held control of the works for some time back. The sale was in reality made to enable Mr. Watts to effect a reorganization of the Company, according to his individual wish.

The proprietors of the Lebanon (Pa.) Gas Company have decided to rebuild the plant. The cost of the improvements is put at $30,000.

The reduction in the Northampton (Mass.) Gas Company's selling rate, takes effect on October 1st. The new schedule calls for $1.60 per 1,000 cubic feet, but the concession is obtainable only by those who settle their bills five days after the presentation of the same.

The J. J. Foster Gas Works, of Greenville, Mich., which have hitherto been operated under that title, but as a proprietary concern, were formally incorporated some days ago. The concern is capitalized in $20,000.

Mrs. Sarah Keeler has brought suit against the Wallingford (Conn.) Gas Light Company for damages in the sum of $1,500, which she alleges is a fair estimate of the value of two elm trees which fronted her property on Main street for upwards of 40 years. She avers that they were killed by gas that escaped from "the mains of the Company, negligently constructed and cared for." The case will be tried in New Haven on the 3d September.

A correspondent at Indianapolis, Ind., forwards the following: "The Citizens Gas and Fuel Company, of Terre Haute, Ind., was sold by the assignee on the 13th inst., for $98,846, and immediately afterward the assignee was served with a restraining order, but he executed the deed because the special judge had been appointed by telegraph, which was held to be invalid. An objecting stockholder, who has prevented the consolidation of the Citizens Gas and Fuel Company and the Terre Haute Gas Light Company for more than a year, obtained the restraining order, and in his complaint makes sensational charges about the manner in which the assignment was procured. Under the Indiana law consolidation could not be effected so long as a single stockholder objected, and the assignee's sale was to obviate this. The property was purchased by the syndicate of whom Mr. John D. McIlhenny is the active member; and it is understood that—this syndicate had already secured control of the Terre Haute Gas Light Company—the selling rate for gas will be advanced to $1 per 1,000. During the long-continued gas war at this point the rates have been as low as 50 cents per 1,000."

The proprietors of the Hazelton Boiler Company, of this city, report a marked improvement in business. They have recently booked a number of desirable orders, among which are duplicates from such prominent concerns as the Rochester (N. Y.) Gas and Electric Company; Messrs. Alden Sampson & Sons, oil-cloth manufacturers, New York City; the Lester-Shire Manufacturing Company, of Lester-Shire, N. Y.; and the Four Lakes Light and Power Company, of Madison, Wis. All of the orders are for large-size boilers, and, save in one instance, the purchasers have from two to six boilers of the Hazelton type that have been tried and not found wanting over a practical working period of from five to seven years.

The Equalization Board, of Duluth, Minn., has assessed the franchise of the Duluth Gas and Water Company, for purposes of taxation, at $125,000.

Something over a fortnight ago the Supreme Court of Kansas issued a writ of *habeas corpus*, returnable September 3d, in the case of W. S. Pryor, of Iola, Kas., against the authorities of Iola. Mr. Pryor, who is the Manager of the Iola Natural Gas and Coal Company, was fined $30 and costs, together amounting to $48, for collecting $1.50 from a customer on account of gas supplied for cooking purposes in his residence during the month of July. The city ordinance of Iola declares that the rate for such use shall not exceed $1 per month, and for violating said ordinance Mr. Pryor was convicted in a Police Court, and before Judge J. P. Duncan. Defendant refused to pay the fine and costs and was ordered sent to jail. He sought relief by appealing the case to the Supreme Court.

Mr. H. H. Kelley, whose resignation as Assistant Superintendent of the Waltham (Mass.) Gas and Electric Company, and his acceptance of the management of the Hamilton (O.) municipal gas plant, have been noted in the Journal, prior to his departure for Hamilton was presented by the employees of the Waltham Company with a beautiful gold watch and chain and a complete set of drafting instruments. The presentation was made by Col. Spaulding.

"A. D. T." forwards the following from Grand Rapids, Mich.: "Judge Adsit has appointed Mr. William S. Walker as 'next friend' of Florence D. Walker (an infant of three years), in order that a suit may be instituted against the Grand Rapids Electric Light and Power Company for $10,000 damages for personal injuries. The declaration recites that on December 23, Florence D. Walker was playing at the corner of Lake and Cherry streets when a lamp tender of the Electric Company threw the remnant of a carbon from an arc lamp from the top of an electric tower to the ground—the tower is 150 feet in height. The carbon struck the child on the right eye, tearing away the iris, completely severing the ciliary body and destroying the sight. The declaration charges the Company with criminal negligence and demands damages in the sum named. The carbon was 6 inches in length, and that it was thrown rather than dropped is substantiated by the fact that it struck the ground at a point 35 feet from the base of the tower."

The New York Marine Paint Company, of Poughkeepsie, N. Y., has been awarded the contract for supplying the material for repainting the Poughkeepsie bridge, which is now a part of the system of the Philadelphia, Reading and New England Railroad. The award was made subsequent to an investigation of the material by the Railroad Company's Chief Engineer, Mr. J. F. O'Rourke. About 12,000 gallons of the paint will be required, and there was sharp competition for the contract.

It will be remembered that the Board of Gas and Electric Light Commissioners, of Massachusetts, on the petition of the authorities of Blackstone, and after an examination of the merits of the case, recommended that the Woonsocket (R. I.) Electric Machine and Power Company (which concern supplies current for the public lighting by arcs of Blackstone) reduce the rate per lamp charged for the service. The Company refused to accept the recommendation, whereupon the Commissioners issued a peremptory order directing it to carry on the work at the "recommended" rate. In view of the fact that this is the first instance in which the recommendation of the Commissioners was disregarded, we reproduce the text of the mandatory order.

COMMONWEALTH OF MASSACHUSETTS, IN BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS, BOSTON, August 15th, 1895.

On the petition of the Selectmen of the town of Blackstone, praying that the Woonsocket Electric Machine and Power Company may be directed and required to supply the inhabitants of said town with electric lights for the purpose of lighting its streets, due notice having been issued to said Company to appear and show cause why the prayer of the petition should not be granted, and said Company having appeared in answer thereto and been heard in the premises;

Ordered, That said Woonsocket Electric Machine and Power Company be, and the same is, hereby directed and required to supply to the inhabitants of the town of Blackstone electric arc lights for the purpose of lighting the streets of said town and upon the following terms and conditions, to wit:

The said lights shall be arc lights of the quality known as nominal 2,000-candle power, and shall burn all night, or from dark to daylight every night. The said lights shall be of such number and in such location as the Selectmen of said town shall from time to time, in writing, request, provided, however, that the total number of lights so requested shall not be less than 29, to be located in the same places as those heretofore supplied to said town by said Company, and provided, further, that the Company shall not be bound to supply lights in locations where the reasonable average cost of extending its lines to the locations named in any one request shall exceed $50 for each of said locations.

Payments for all lights supplied under this order shall be at the rate [42 cents per lamp per night] named in an order of this Board adopted on July 8, 1895, upon petition of the Selectmen of said town, with the pro rata rebate for any total failure of service of said lights or of any of them caused by accidents or civil or elementary commotion, and shall be made in monthly installments, the amount due for each month to be paid or tendered within three days after the adjournment of the next regular meeting of the Selectmen of said town at which bills are payable.

These terms and conditions shall continue and be in full force except and in so far as the same may be modified by the mutual agreement of said town and Company.

This order shall be in full force and continue only until the Selectmen of said town shall notify said Company to cease to supply lights or until the same is otherwise modified or annulled by this Board.

A true abstract from the records of the Board.—R. G. TOBEY, Clerk.

THE consolidation of the gas interests of Newark, N. J., will be formally and finally completed during the first week of September. We may also say that Mr. Vanderpool has no intention of retiring from the gas business.

ELSEWHERE we note the determination of the proprietors of the Lebanon (Pa.) Gas Company to virtually rebuild that plant, and in supplement of that mention we give the following from the Lebanon *News* of the 17th inst.: "The Board of Directors of the Lebanon Gas Company have for some time had in contemplation the improvement and enlargement of their plant in the western section of the city, and with that end in view have visited large and improved works at Pittsburgh, Philadelphia and other cities. On the afternoon of the 16th inst. a meeting of the Board was held and well formulated plans were submitted. It was voted to rebuild the generating plant this season, at an expense of from $20,000 to $25,000, and work will commence at once. It is expected to have the new plant in practical operation in about 90 days. This is only a portion of the proposed improvements and extensions which the Company contemplates executing at an early day, and at some future time we will be able to give our readers facts and particulars that will be of general interest. The capital stock of the Lebanon Gas Company is $80,000, and by reason of careful management the stock has increased in value until it is now far above par, and it seldom happens that any is offered for sale. These improvements will be a burden upon the stockholders for the time being, but reposing full confidence in the people who are looking for a cheaper gas for heating and cooking purposes, the Directors have unanimously decided to make the improvements which will undoubtedly meet with the general favor of our residents. The Lebanon Gas Company, it might be here stated, was organized in 1856. Until his death, the late Col. T. T. Worth, at the head of the journalistic profession in this part of the State, was its honored and esteemed President, while the ever active and vigorous Col. John W. Mish, who seems to be constantly quaffing at the fountain of youth, was from the beginning and is now the able and reliable Secretary and Treasurer. In his hands the finances of the Company have been wisely and carefully managed and much of the Company's success is due thereto. The contemplated improvements will be made under the supervision of Superintendent C. F. Smith, who knows all there is worth knowing about the manufacture of gas, and will give Lebanon such a plant as it may well be proud of. We congratulate the Lebanon Gas Company upon the great step forward it has taken."

THE City Council, of San Jose, Cal., has awarded the contract for the public lighting, by arc lamps, of that place to the San Jose Light and Power Company, at its bid of $8.90 per lamp per month. The bid submitted by the San Jose Electric Improvement Company was $8.94 per lamp per month. The contract is for one year, from October 1st next. President Quilty, of the San Jose Light and Power Company—we take it for granted that our readers are aware of the fact that this Company also controls the gas supply of San Jose—said he would get that contract, and he has made good his assertion; nor was there any favoritism shown, since Mr. Henry Edwards, of the Electric Improvement Company, admitted openly that the successful bidder "had secured the contract after a fair and square contest."

THERE are 30 street lamps of the Welsbach type in use at Napa, Cal., and the service is quite satisfactory to the authorities and to the residents.

THE new Pintsch system gas plant at Indianapolis, Ind., is in working order. All the trains of the Big Four system are lighted with Pintsch gas.

THE Winona (Minn.) Company is making notable extensions in its main system.

SOME time ago a suit was brought against the proprietors of the Norwalk (O.) Gas Light and Coke Company by certain residents on Whittlesey avenue, that city, who claimed that the operation of the plant was a nuisance and that it was detrimental to the health of those who lived nearby it. The case was tried before a jury, who returned a verdict for the defendant.

ON the 15th inst. an explosion of gas occurred in the office of the works of the Kansas City (Mo.) Gas Light and Coke Company. It is conjectured that a leaky seal in the purifying room was responsible for the gas escape. Prompt action on the part of the fire department checked the flames before much damage was done, and the loss is less than $500. At one time it looked as if the meter room would be destroyed.

J. FRANK ALDRICH has notified the City Council, of Peoria, Ills., that he will accept the ordinance recently granted himself and associates to operate a gas works in that city. He had until the 25th inst. to accept or reject the franchise.

THE market for coal gas tar shows unmistakable signs of a good, round increase in the price therefor.

ABOUT a year ago the Gas Light and Coke Company, of London, England, commenced the placing of automatic gas meters, and now 13,249 of the meters are at work, and orders for 6,000 more are in hand.

MR. M. N. DIALL is to remain in charge of the works of the Terre Haute (Ind.) Gas Light Company; which special piece of information is given for the benefit of the rumor mongers who had it that Mr. Diall was to be superseded. Beyond a doubt Mr. Diall is the right man in the right place.

THE Welsbach Commercial Company issued the following circular under date of the 1st inst.: "*To the Trade.*—On and after August 5th, until otherwise advised, there will be an advance of 25 cents each over trade price list No. 7 on Welsbach lights. Prices of mantles for renewals, glassware, etc., will remain as at present until further notice. All prices are subject to change without notice as heretofore."

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

MONDAY, AUGUST 26, 1895.

Gas Light and Coke Company's Residual Returns for the Half Year.

Col. W. T. Makins, Governor of the Gas Light and Coke Company, London, in moving the adoption of the report and accounts of the business of that concern for the last half year, had this to say about the residuals account:

As to coke, although the price had been low during the past few months, the saving in the fuel account had yielded an increased revenue which was more than sufficient to meet the loss on the price. That exceedingly satisfactory state of things they owed to their engineers, who had exerted themselves to the utmost to effect economies in the carbonizing of the coal in the retort houses. It was due to them to mention their success, and how the Company was indebted to them. In regard to coke the Company was in rather an awkward position as compared with other companies. The bulk of the Company's coke was made a long way down the river, away from houses and population, and had to be disposed of to the cement manufacturers. That was in itself a disadvantage, and the recent depression in the cement trade had contributed to keep the price at a low level. He was glad to see, from a document issued by the great cement manufacturers of the district, that there had been a considerable increase in the volume of trade, and that they were able to secure higher prices. That being so they might infer that the depression in the coke trade was not likely to be very long or very pronounced, and with the passing away of the depression better prices for coke might be expected. Tar and tar products had yielded an increased revenue, there being a difference of $92,500 in favor of this half year. The yield per gallon of tar was 3.90 cents, which was an exceedingly satisfactory one, and compared favorably with the prices obtained generally in the market. The market for sulphate of ammonia had been abnormally dull and lifeless. That was consequential on the bad agricultural season of last year and the late sowing season of the present year. Both combined put it out of the power of the farmers to sell their corn and expend the proceeds on artificial manure. That same cause, too, had operated unfavorably on the traffic of railway companies. All feeding stuffs growing on the land, with the exception of barley, had been utilized for the feeding of stock, and in this way what would otherwise have been forwarded by rail to the markets had been retained for consumption at home. The Company held a considerable stock of sulphate, and when the market for it was affected in the way described their policy was not to sacrifice it by forcing its sale, but to value it on their books at a safe and reasonable amount, even at a lower sum than the ruling market price, and then to wait for better times. He was certain that, as a general commercial policy, that was the proper course to pursue under the circumstances. If ther was a good harvest this year a good demand would spring up for artificial manure, and the Company would be correspondingly benefited.

Projected Tests of Fireproofing.

Engineering Record notes that the important subject of the practical value of fireproofing is about to be investigated in a scientific manner by a committee appointed for that purpose; and it is hoped that the results obtained will prove a valuable addition to our present knowledge. It is proposed to carry out experiments on a large scale, and among other things, to test the effect of an intense fire on the structural iron and steel so universally employed at the present time, and the effect that the different fireproofing materials may have in protecting the same.

The committee has been jointly selected by the fire insurance companies, the architects and the engineers, and consists of Mr. S. A. Reed, representing the Tariff Association of New York, Mr. George L. Heins, the Architectural League of New York, and Messrs. H. de B. Parsons and Thomas F. Rowland, Jr., the American Society of Mechanical Engineers. As the report of the committee is expected to contain some valuable information, not only the manufacturers of fireproofing materials, but also the public in general, are invited to offer their assistance, as the committee's expenses are to be met entirely by voluntary contributions. The manufacturers of fireproofing materials are, however, not allowed to subscribe, but are asked simply to defray the expenses of erecting and removing their materials to be tested. The Carnegie Steel Company, through its agent, Mr. Whitney, has kindly offered to give the committee all the iron and steel that may be required, and the Continental Iron Works, Brooklyn, N.Y., has consented to give the ground necessary for the erection of the furnaces. The time of the members of the committee is freely given to the advancement of scientific knowledge, and it is intended to make the tests thoroughly impartial.

The committee has organized, and has begun to build the required plant. There will be a gas producer to supply the fuel gas, so arranged to receive a spray of petroleum in case higher temperatures may be required than those obtained from the combustion of gas alone. Furnaces for testing full-sized columns and floors will be erected. The foundations of these furnaces will consist of side walls with an arch between them, thus making a safe place for the introduction of the gas pipes and for the hydraulic cylinder. On the top of this foundation will be erected a room built of the materials to be tested. The columns will be loaded by pressure from the hydraulic cylinder, and during the tests a safe load, such as is prescribed by the building laws of New York City, will be put upon it. The arches for the floors will be loaded by dead weight. Every precaution will be taken by the committee to make the tests uniform as regards temperature, draft, cooling by water streams, etc., so that the results may be comparable. The committee will take minute notes of all details and publish them, together with the results, in its final report. The committee would be pleased to communicate with anyone who may be interested in this matter. Its address is Room 106, 22 William street, New York.

The Market for Gas Securities.

Consolidated was a trifle heavy this week, sales having been reported at 141 on Tuesday last. Towards the close, however, a firmer tendency was shown, and the opening to-day (Friday) came in at 142 bid. The investor of these times is seemingly satisfied with a 5 per cent. return on his money, provided the value behind the paper is there, wherefore it is rather strange that Consolidated should not be selling at 160, even at the dividend rate of 8 per cent. per annum, for its real estate holdings are fully worth its capital stock at par. This fact will be appreciated sooner or later, meanwhile those who "appreciate" it first will be the chief gainers. Other city shares are dull and strong, notably Standard preferred, which is bid 108. Central is also in the ascendant. Brooklyn gas shares are unchanged, with Equity the disturbing factor, as usual. Chicago gas, after selling up to 63⅜ and down to 59½, came in this morning at 61½. The stock is a purchase. Baltimore Consolidated is higher, at 63½ to 63¾, and Consumers, of Jersey City, is 92 bid. Bay State is weak and lower, at 19½ to 20. Lacledes held their own, and it looks that they are cheap at anything under 30.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

August 26.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	142	143¼
Central	500,000	50	150	..
" Scrip	220,000	..	100	..
Equitable	4,000,000	100	195	..
Bonds, 6's	1,000,000	1,000	106	..
" 1st Con. 5's	2,300,000	1,000	113	115
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	171	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
Northern	150,000	50	90	91
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	3⅜	3½
Preferred	2,000,000	100	54	56
Bonds	3,500,000	1,000	90¾	92
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	65	68
Preferred	5,000,000	100	108	..
Bonds, 1st Mortgage, 5's	1,500,000	1,000	107¾	..
Yonkers	290,650	50	112	
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	125	..
Citizens	1,200,000	20	65	..
" S. F. Bonds	320,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	175	..
" Bonds	300,000	..	108	..
Peoples	1,000,000	10	90	..
" Bonds, 7's	368,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	170	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	225	..
" Ctfs.	700,000	1,000	99	100
Williamsburgh	1,000,000	50	210	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	50	19⅝	20
" Income Bonds	2,000,000	1,000	23	..
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	..	80
2d " " "	3,000,000	1,000	51	55
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	.....	..	95	..

Chicago Gas Co.	25,000,000	100	61¼	61¾
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	98	98½
Columbus	1,089,000	..	63	66
1st Mortgage	1,085,000	..	91	93
Consumers, Jersey City	2,000,000	100	92	..
" Bonds	600,000	1,000	100¼	..
Cincinnati G. & C. Co.	7,000,000	100	203	203¼
Consumers, Toronto	1,600,000	50	184½	187
Central, San Francisco	.....	..	95	..
Capital, Sacramento	.....	.	..	41
Consolidated, Baltimore	11,000,000	100	63¼	63½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	30¾	..
" Con. Bonds	4,312,000	..	75	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	72	74
" Bonds	2,000,000	..	85	..
Hartford	750,000	25	120	128
Indianapolis	2,000,000	..	150	155
" Bonds, 6's	2,650,000	..	105½	..
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	85	86
Bonds	1,000,000	1,000	88	90
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	26	27
Preferred	2,500,000	100	84	86
Bonds	9,034,400	1,000	97¼	97½
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	..
New Haven	.....	25	225	..
Oakland, Cal.	.....	..	45	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
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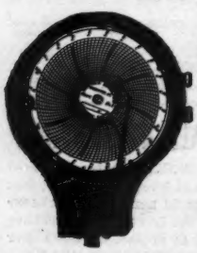

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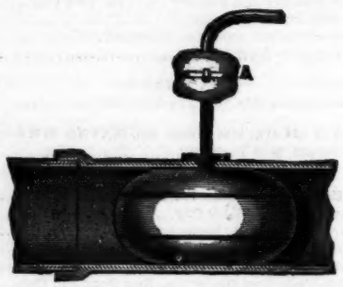

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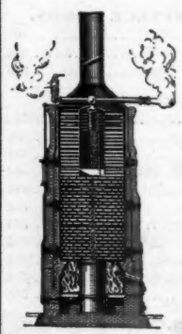

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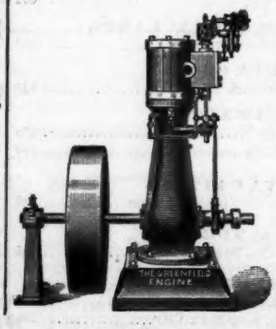

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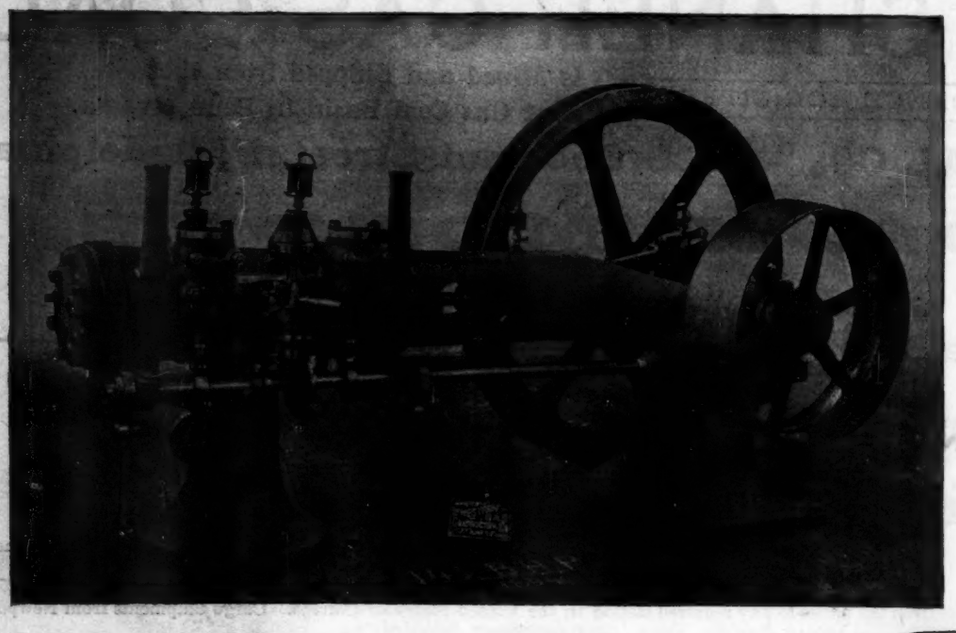

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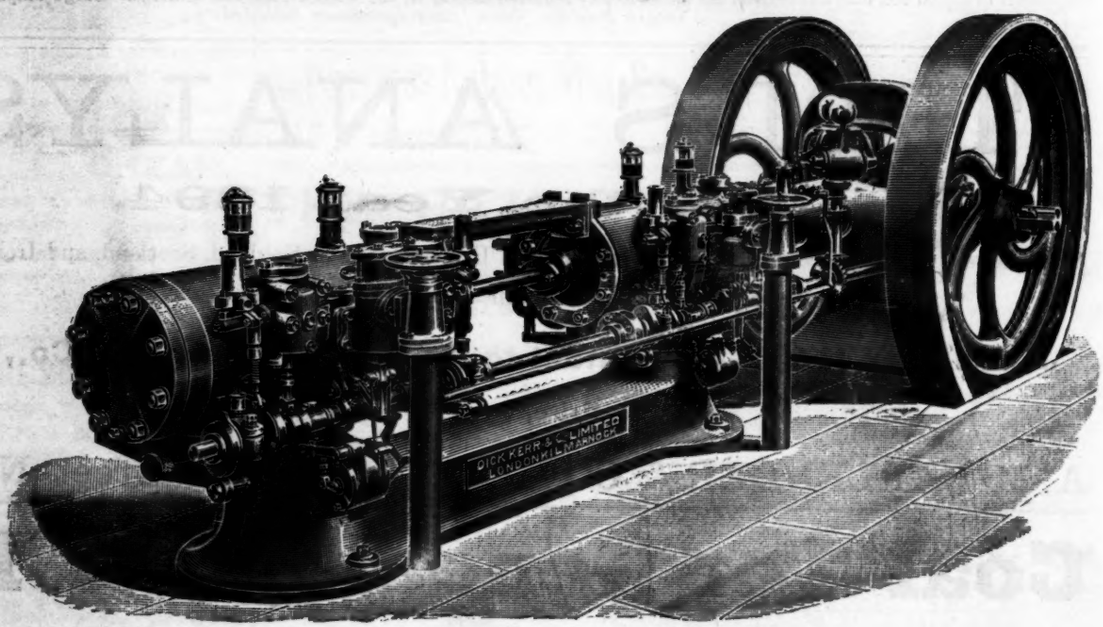

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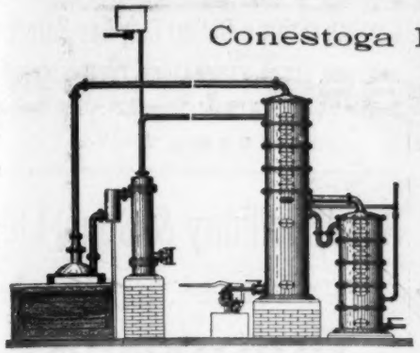

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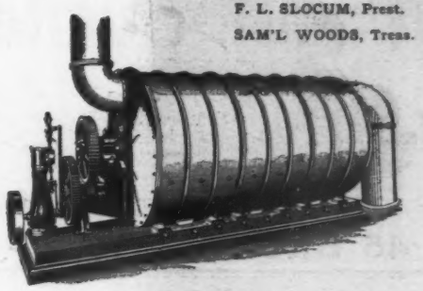

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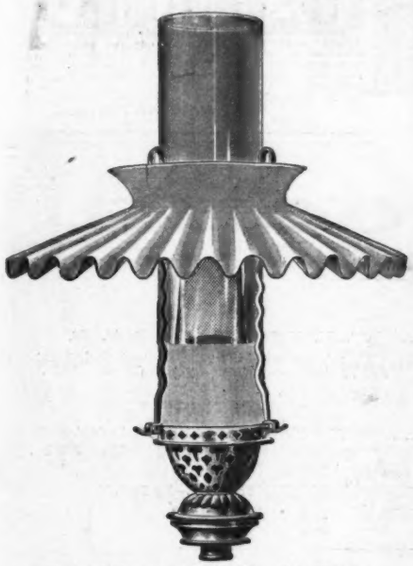

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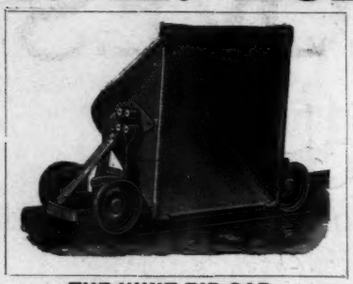

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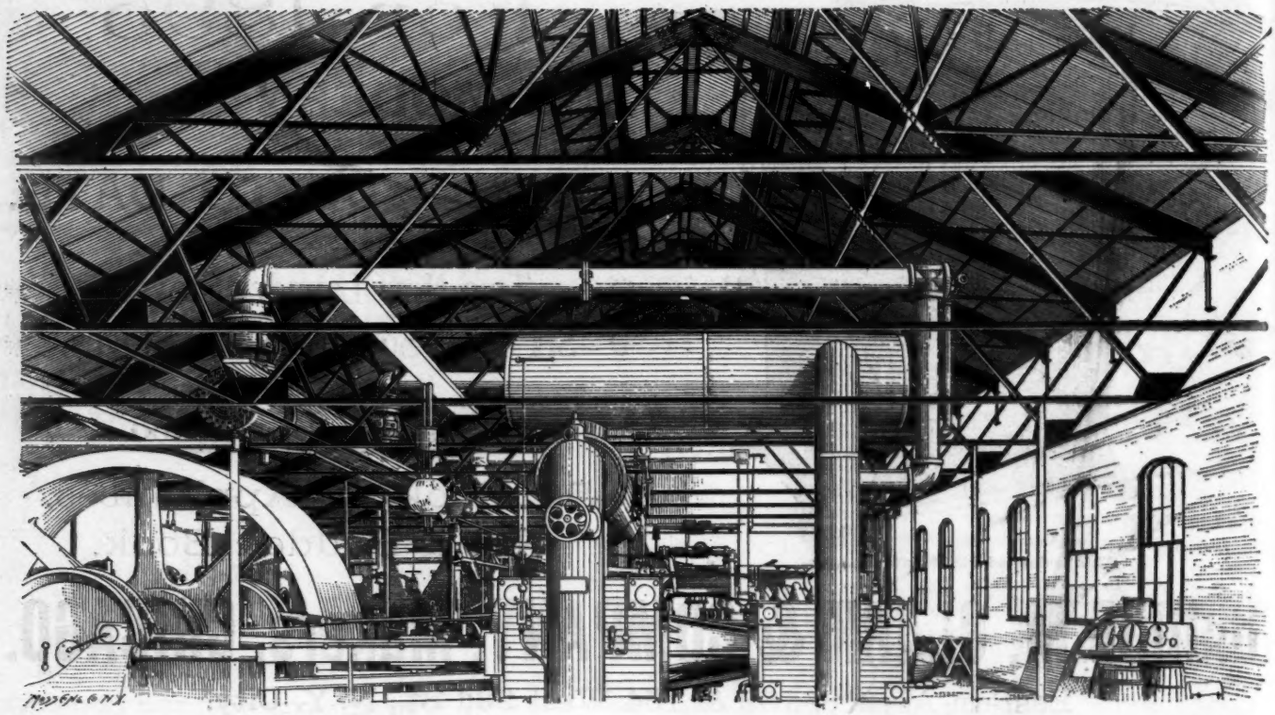

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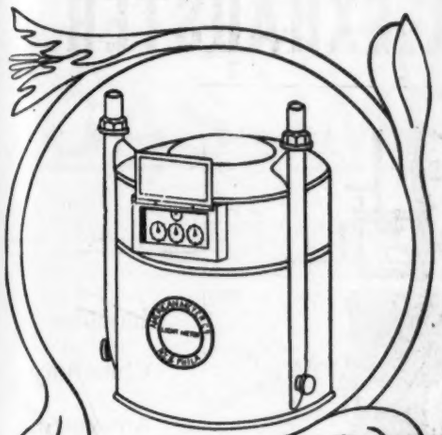

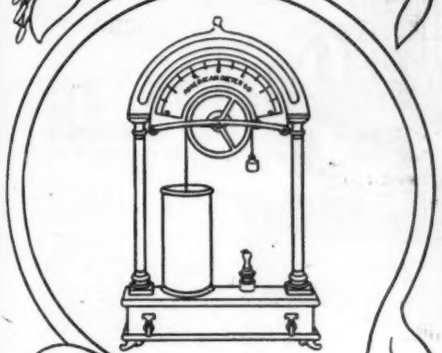

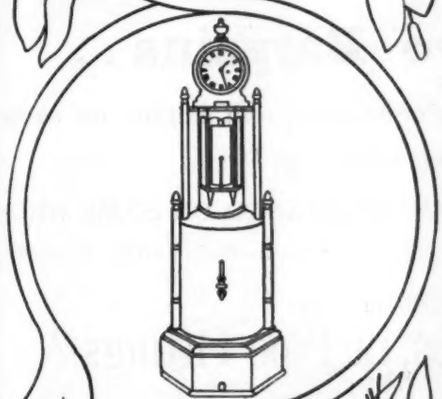

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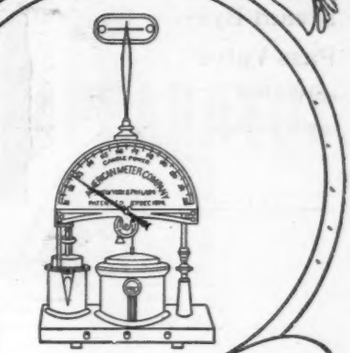
PUBLIC LIGHTING TABLE.

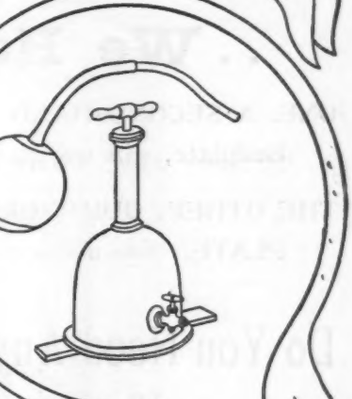
SEPTEMBER, 1895.

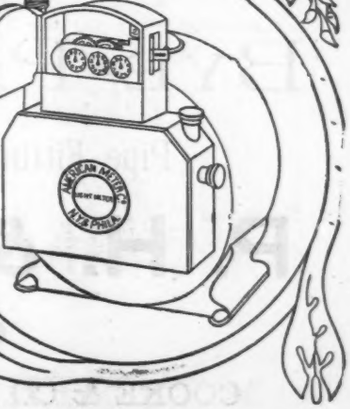
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sun.	1	2.40 AM	4.30 AM	6.30	4.20
Mon.	2	No L.	No L.	6.30	4.20
Tue.	3	No L. FM	No L.	6.15	4.30
Wed.	4	No L.	No L.	6.15	4.30
Thu.	5	6.50 PM	8.00 PM	6.15	4.30
Fri.	6	6.50	8.20	6.15	4.30
Sat.	7	6.50	8.40	6.15	4.30
Sun.	8	6.50	9.00	6.15	4.30
Mon.	9	6.50	9.30	6.15	4.30
Tue.	10	6.50	10.10	6.05	4.40
Wed.	11	6.50 LQ	10.50	6.05	4.40
Thu.	12	6.50	11.50	6.05	4.40
Fri.	13	6.50	1.00 AM	6.05	4.40
Sat.	14	6.50	2.20	6.05	4.40
Sun.	15	6.30	4.40	6.05	4.40
Mon.	16	6.30	4.40	6.05	4.40
Tue.	17	6.30	4.40	5.55	4.50
Wed.	18	6.30 NM	4.40	5.55	4.50
Thu.	19	6.30	4.40	5.55	4.50
Fri.	20	6.30	4.40	5.55	4.50
Sat.	21	6.30	4.40	5.55	4.50
Sun.	22	6.30	4.50	5.55	4.50
Mon.	23	7.40	4.50	5.55	4.50
Tue.	24	8.30	4.50	5.40	5.00
Wed.	25	9.30 FQ	4.50	5.40	5.00
Thu.	26	10.30	4.50	5.40	5.00
Fri.	27	11.30	4.50	5.40	5.00
Sat.	28	12.30 AM	4.50	5.40	5.00
Sun.	29	1.40	5.00	5.40	5.00
Mon.	30	2.40	5.00	5.40	5.00

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146.30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45







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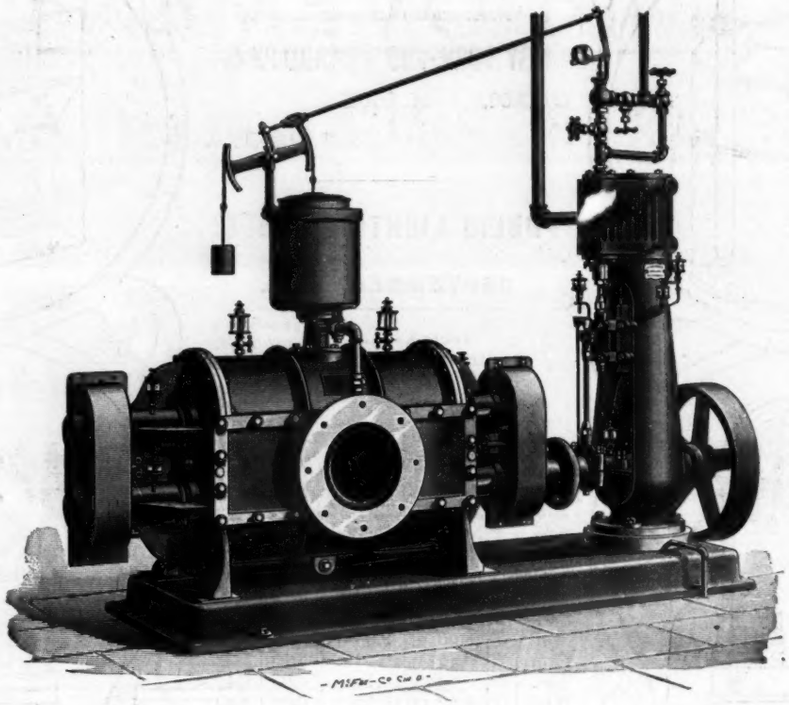

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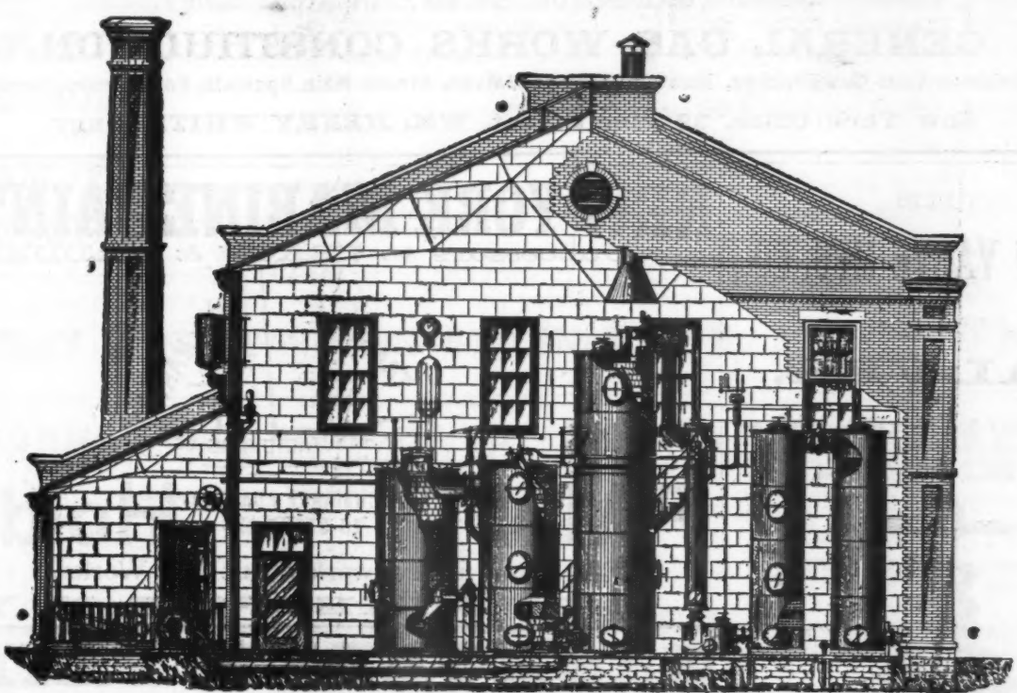

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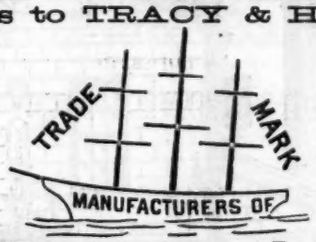

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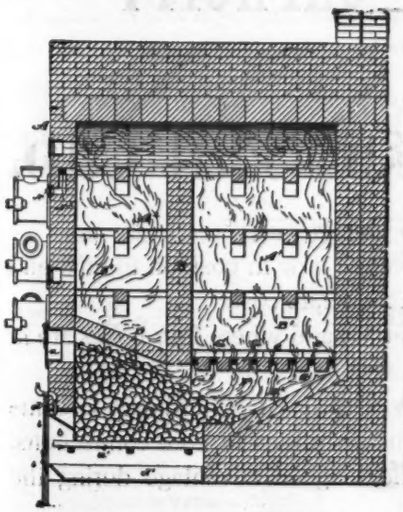

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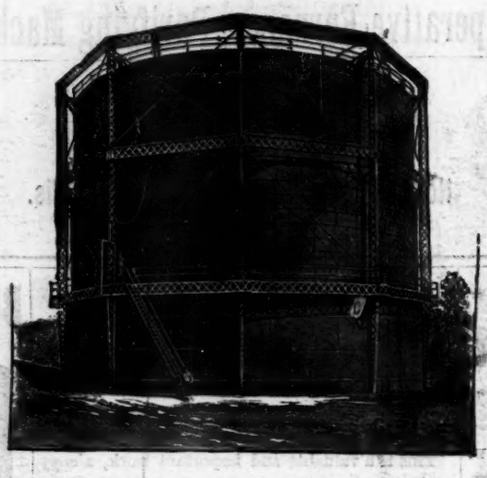

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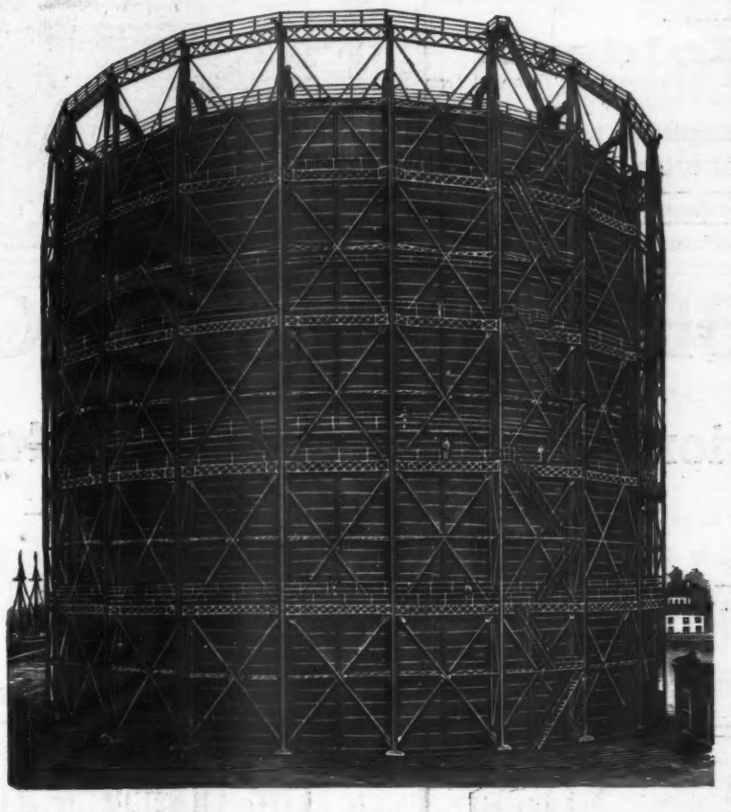

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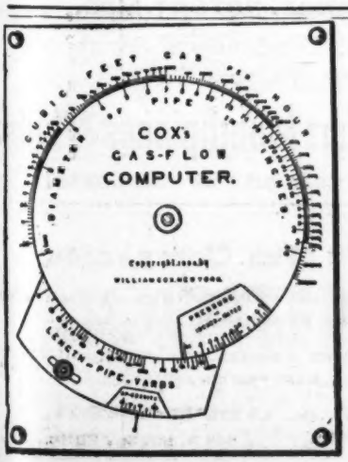

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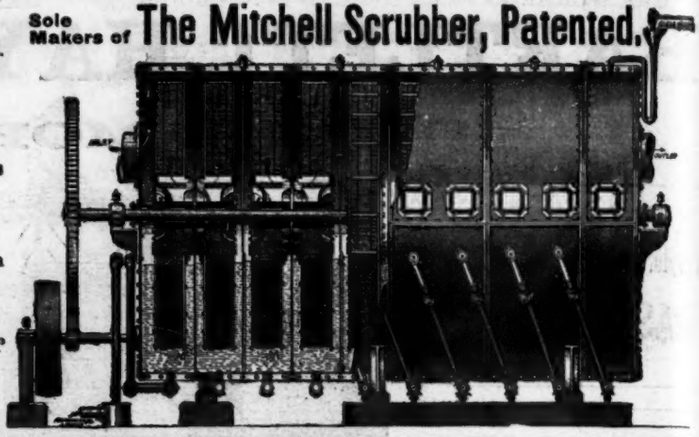

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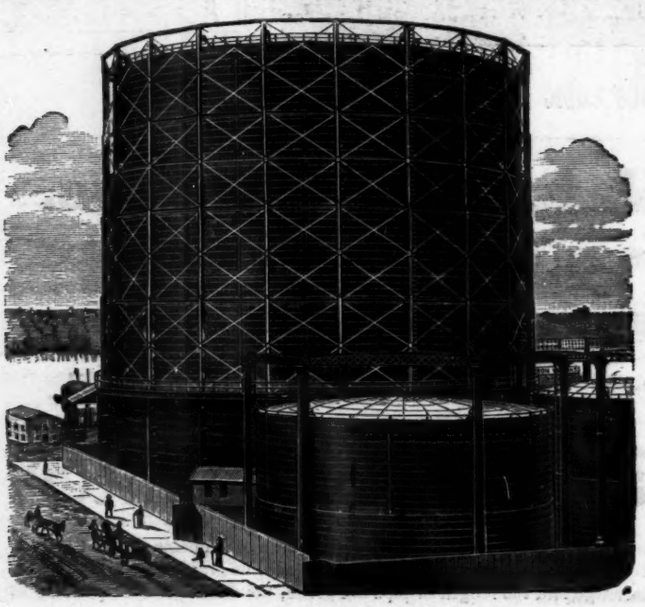

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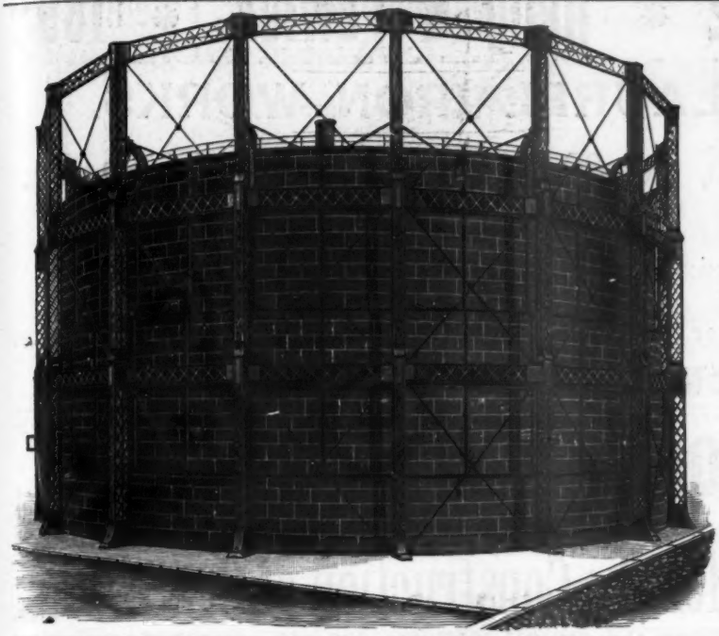

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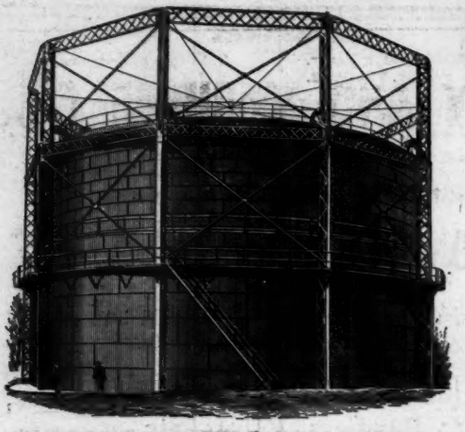

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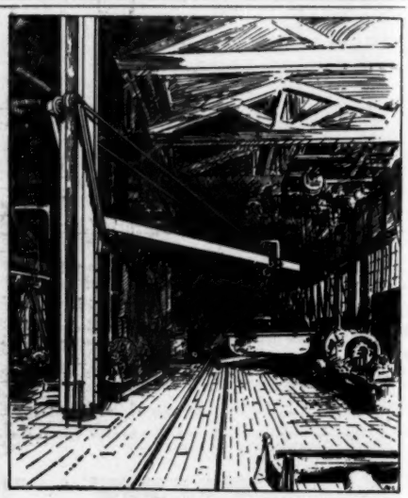

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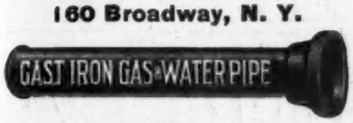

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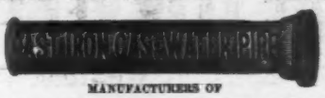

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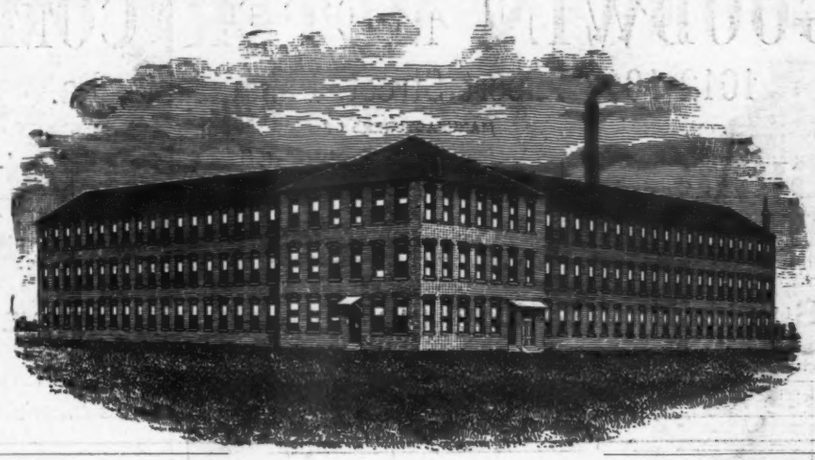

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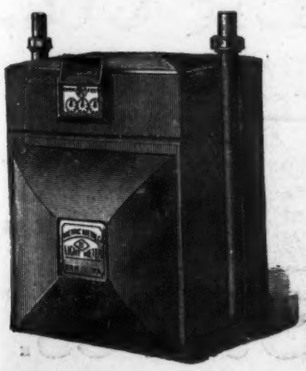

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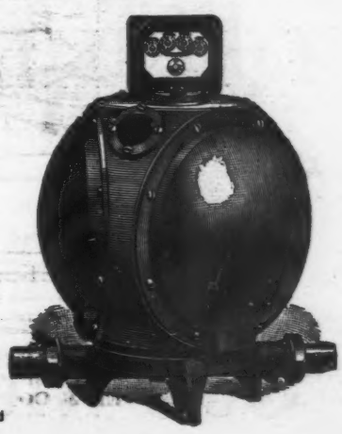

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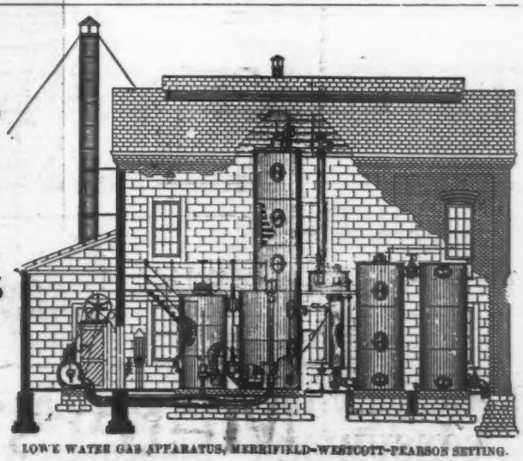

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